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# ANALYSIS OF PROGRAM FACTOR-DEMAND RELATIONSHIPS FOR M-16 RIFLE PARTS (U)



## FINAL REPORT
## NOVEMBER 1969

BY
STEVEN GAJDALO
INVENTORY RESEARCH OFFICE

UNITED STATES ARMY LOGISTICS MANAGEMENT CENTER
FT LEE, VIRGINIA



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## (U) ABSTRACT

This report contains results of an empirical study of the relationship that exists between demand for parts of the M16 Rifle and rifle density or round expenditure. Actual demands from Vietnam and the actual monthly density and round expenditure in Vietnam for 1967 and 1968 are used in the analyses.

Relationships are examined for the DSU and the NICP levels of supply. Patterns of overall round expenditure and density as well as patterns of a finer breakdown of the overall, i.e., by type of mission, terrain, and combat status of units, are compared with patterns of demand and dollar value of the demand for individual items, for the catalog of items, and for aggregation of items by three class types. Forecasts of density and round expenditure as given in DA-1322 reports are compared with the actual values.

For both levels of supply, density appears to have no bearing on demand. Round expenditure seems to affect demand but the changes are not proportional. Forecasts of round expenditure are not very good. A demand forecast methodology is suggested and guidelines given to what extent future analysis of this type should be carried.

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## (U) SUMMARY


1. Problem and Background

The Chief of the Intensive Management Office of the Supply and Maintenance Directorate at Weapons Command asked the AMC Inventory Research Office to determine the correct rifle density-parts demand relationship for the M16 Rifle. Such a relationship, if any, would be helpful in determining future spare parts needs of the M16 Rifle.

A direct relationship is currently used. Any change in future parts demand is assumed to be exactly proportional to the change in rifle density. Thus, for example, if the future rifle density in some quarter is expected to be 20% higher than the average quarterly rifle density of the past, the parts demand for that quarter will be forecasted to be 20% higher than the average past quarterly demands. Recent forecasts for rifle parts based on this direct relationship proved to be unsatisfactory. Although there could be many reasons for large forecast errors, e.g., extremely erratic demand, or a change in the demand pattern, the Chief of the Intensive Management Office felt that the errors were large because the assumption of direct relationship may not be valid. He felt that even if demand is correlated with rifle density there might be a delay between the time that rifle density increases and the time that the demand will increase or that the relationship might not be linear. We feel that the same doubt occurred to many item managers.

2. Purpose and Objectives

The purpose of this study was to investigate what relationships exist between demand for parts of the M16 Rifle and rifle density. Specifically, the purpose was to investigate, (a) if demand is dependent on density, (b) if there is a lag between the time that a change occurs in density and the time that this change causes a change in demand, and (c) if the change in density results in exactly a proportional change in demand.

The objective was to improve the forecast of rifle parts by making available a relationship that actually exists for demand and density instead of a relationship that is assumed to exist.

3. Scope and Methods

(a) The analyses were extended to include relationships between demand and round expenditure. Results apply to the DSU and NICP level of supply.

(b) The analyses were limited to the U.S. Army in Vietnam demand (source of the bulk of NICP demand) and program data (density and round

expenditure) for the M16 Rifle parts.* However, we believe the results may be typical and therefore applicable to any weapon system.

The method of analysis used was simple comparison of the time series and reliance on what was evident to the eye. We were not interested in knowing, as a result of statistical analyses, that demand is not dependent on density or round expenditure on a month to month basis. This was obvious from mere inspection of the time series. We were interested in knowing whether or not demand changed in the same direction as a program factor on an average basis. To know that demand in the long run will change if density or round expenditure changes, and the size and direction of this change, is all that is necessary to know how density or round expenditure should be used in adjusting demand forecasts. To get this information from formal analysis requires longer time series intervals, e.g., six months instead of one month as we used. However, doing this with the intention of having meaningful results requires longer histories than the two years we had.

An attempt was made to see only the true process of the variables (demand, density, round expenditure) and exclude or give less weight to observations that were caused for the most part by a volatile environment. The criterion used in identifying these observations was based on the effect they had on stock positions. If a few observations raised the average in the time series to a level above the rest of the observations, stock positions based on this level would be on the average much higher than needed for efficient supply control. These observations were, therefore, smoothed or excluded.

In Chapter II the program factor-demand relationships at the NICP level of supply are examined. An attempt is made to establish general patterns of weapon density, round expenditure, and demand, in that order. Patterns are then compared to determine what relationships exist.

For the program factors, actual experience is compared with forecasts to determine how good are forecasts of program factors. However, in comparison with the demand patterns, patterns of the actual (as opposed to forecasted) data are used. Comparisons are made for patterns of overall round expenditure and density as well as patterns of a finer breakdown of the overall, i.e., by types of mission, terrain, and combat status of units, on the one hand, with patterns of demand and dollar value of demand for individual items, for the catalog of items, and for three classes of items, on the other.

In Chapter III the program factor-demand relationships at the DSU level are presented. Every data relationship examined for the NICP level was also examined for the DSU level. However, only the more substantiative results of this duplication are presented. Chapter IV puts the results in perspective and a management approach is suggested. Chapter V expands on the suggested approach.

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* In the context of this report, <u>parts</u> includes all parts integral to the rifle, accessories, and cleaning equipment.

A dotted line appears in most of the figures. This dotted line represents the assumed true average value of the variable in the figure obtained by averaging the corresponding sample of observations after it has been modified as discussed above to reflect the true process. In some cases two true averages are shown. These were not necessarily for a specific year but, instead, for what appeared to be a stationary interval. The pattern is termed a "RAMP" or a "STEP" if the true average looks like a RAMP or has a STEP. An "IMPULSE" refers to an observation which is much larger than can be expected even with a liberal allowance for variability. Some terms will be found that might be given a statistical interpretation. These should be given a layman's interpretation.

## 4. Findings and Conclusions

a. On an item by item basis, demand does not depend on density nor on round expenditure. Demand for individual parts is generally random and is always highly variable. The inherent component of variability is sufficient to obscure any correlation that might exist.

b. If all items are taken as a group, both demand and the dollar value of this demand do not depend on density.

c. If all items are taken as a group, both demand and the dollar value of this demand depend on round expenditure. There is no lag, and the amount of change differs. The approximate relationship can be expressed as: (% change in demand ($ value of demand) for catalog of items) = 60% (% change in round expenditure).

d. If items are grouped into cleaning equipment, accessories, and integral rifle parts, demands or the dollar value of the demands for these groups depend on density and round expenditure as follows:

(1) Cleaning equipment - not dependent on density; dependent on round expenditure as in (c) above.

(2) Integral rifle parts - not dependent on density; dependent on round expenditure as in (c) above except that demand or dollar demand lags round expenditure by three (3) months.

(3) Accessories - not dependent on density; not dependent on round expenditure.

e. Patterns of round expenditure by mission or terrain are similar to the pattern of total round expenditure. Likewise, pattern of density in the hands of combat units in Vietnam and pattern of density in the hands of non-combat units in Vietnam are similar to the pattern for total density in Vietnam.

f. Forecasts of density and round expenditure are not very good.

These findings indicate that a study should be made with the objective of developing procedures that will improve forecasting of program factors, and more specifically, density and round expenditure. If forecasts of these program factors continue to be bad, then program factors should not be used in demand forecasting.

If good forecasts of program factors can be made available to a commodity manager, then a program factor might be used in demand forecasting if it really influences demand. Based on the results contained herein, round expenditure, rather than density, should be the program factor used. The appropriate relationship depends on the item type as given in (d) above. Some type of monitoring is required because all variables concerned (demand, round expenditure, end item density) are dependent on environment, and environment does change.* A change in the variables might change the nature of the relationship. It is not unlikely that analysis of future demand, round expenditure, and end item density data would demonstrate that demand is more dependent on density than on round expenditure.

It might be induced that if a relationship between demand and program factors cannot be found for aggregation of data, it probably will not be found for a finer breakdown of data. The expected reward for detailed analysis does not justify the required effort. This guideline would exclude analysis of data at a bottom echelon of supply (DSU/GSU level), analysis of demand on an individual item basis, and analysis of distribution of round expenditure by mission or terrain. Note that these comments apply only to analysis for the purpose of determining program factor-demand relationship.

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* A suitable monitoring procedure is given in Chapter V.

# CHAPTER I

## (U) INTRODUCTION AND DESCRIPTION OF SOURCE DATA

### 1.1 Introduction

The initial objective was to find a demand-rifle density relationship as was requested by WECOM. IRO was supplied the weapon density information and, later, two years of MILSTRIP demand data for 92 parts. Although there were about 100 parts that WECOM asked us to analyze, we later found out that only 92 experienced demand in that time period.

When the analysis indicated that demand is not related to rifle density we wanted to find a reason for this and also extend the analysis to include round expenditure. We reasoned that we could not see a relationship because we used the wrong data. What we used were forecasts of all weapons in Vietnam. The forecasts could distort the true shape of the density patterns because the forecasts might have large errors. Using data of total weapons could distort the true picture because it includes all weapons. The idle weapons clearly disguise the true failure rate of the active weapons because the idle weapons are not as subject to wearout or replacement due to abuse. Consequently, we obtained COLED-V data from Research Analysis Corporation (RAC) which gave us various information for those weapons that fired.

When we found that the density-demand relationship for the actual data for weapons that fired was about the same as for the forecasted data for total weapons, we segregated this actual density data into weapons that were fired by combat units and those fired by non-combat units. The rationale is simply that combat units are much more active and therefore failures are more likely. When the result remained the same we argued that demand at the top (NICP level) contained too much induced variability due to the supply chain.* We therefore looked at the demand-density relationship at the DSU level.

When we looked at round expenditure data, we found that total theater (Vietnam) round expenditure and demand were highly correlated. We then looked at round expenditure by mission and terrain in the hope of finding even a higher correlation. This seemed probable because the volume of rounds expended varies among the missions as does the degree of abuse. Terrain or environmental circumstances have a direct effect on some parts. For example, upper receiver, various springs, etc. are subject to rust in damp terrain.

We looked at aggregation over all parts of units demanded and the dollar value of these for two reasons - demand for individual items was apparently independent of both rifle density and round expenditure and such aggregate information is useful for budgetary purposes. Since the patterns of the

*At each level of supply the demand that is passed on reflects an adjustment, if any, in the requisitioning objective.

aggregate demand in units and in dollar value were similar, we dropped the unit aggregation from further analysis because the dollar value aggregation has a more meaningful appeal. To make certain that the apparent good demand correlation with round expenditure and lack of correlation with density was not due to certain types of parts the aggregate plot was segregated into accessories, cleaning equipment, and integral parts.

If there is no phasing(lag), the ratios of units (or $ units) demanded per rifle or units demanded per round expended should remain constant if correlation of demand and density, or rounds, respectively, is perfect. Since phasing could not be detected from the time series plots, these ratios were computed and plotted. However, even if relationships existed they could not be detected by examining these ratios because the plots were greatly distorted by the large amount of noise present in demand. This type of analysis was discontinued in favor of simple eye comparisons of patterns.

Finally, care was taken to exclude from analysis all items for which a great deal of the demand was actually a one for one part exchange due to a technological replacement. The items excluded were bolt assembly and carrier, buffer assembly, and flash suppressor. Incidentally, the demand pattern of these items as a group was very much a decaying exponential - clearly indicating a phase-out situation.

## 1.2 Description of Source Data

### a. MILSTRIP DEMAND DATA

The MILSTRIP data supplied by WECOM were all requisitions received by WECOM since January 1967 through March 1969. These came in two stages on IBM cards which were processed by IRO to include only Army demand from Vietnam. Duplications or erroneous requisitions were easily excluded since they were indicated by code X in column 79 of the card. This resulted in a total of 8339 pieces of data spread over 92 items. A list of these items and how they were categorized is given as Appendix B. In computing the monthly (calendar) summaries, the date of the request rather than the date of processing or issue was used. This was done throughout.

### b. NCR 500 DATA

The NCR 500 system consists of National Cash Register 500 series computers installed at the DSU/GSU level to provide mechanized stock control at these levels. Each transaction is recorded on a ledger sheet for the item which also contains data required for proper stock control. Monthly summary data are kept on the magnetic strips on the back of the ledger sheets. The front of the ledger sheet with typical data is shown as Appendix C. These are the data we used.

These data were obtained in Summer of 1968 by a team from RAC for four DSU's. We in turn obtained copies of the data for M16 Rifle FSN's from RAC. Unfortunately only one of the four DSU's was sufficiently active (with respect to rifle parts demand) to make possible a meaningful analysis. This was the 709th Maintenance Battalion supporting the 9th Infantry Division. The data for the other three DSU's were too few to be analyzed.

For the 709th DSU eleven (11) months of data could be used in the analysis. The initial point (July 1967) was marked by the date of the NCR 500 computer installation at this DSU and the terminal point (May 1968) was marked by the date that the team visited this DSU to extract the data.

You will note in Appendix C that there are many codes to describe the transaction type. The codes are explained in the right hand margin of the sheet. The only transactions that we included in the analyses were those coded 33, 40, 41 and 49. Only these represent demand. Other information of interest is contained in columns 1, 4, and 6 which identify the customer, date of requisition, and size of requisition, respectively. Transaction code is in column 5.

c. COLED-V DATA

These data were also obtained from RAC. As part of meeting the Combat Development Command's responsibility for providing capability to conduct continuing analytical studies on combat rates the COLED-V program was established. This is an input-feedback arrangement whereby all units in Vietnam report various combat information which is processed and summarized then fed back to the units and other parties concerned. RAC does the summarization for each calendar month for sub-units, major units and the Vietnam area as a whole.

The type of information that is outputted every month for every weapon system is:

(a) unit firing days

(b) weapon density

(c) weapon firing days

(d) round expenditure

(e) round/weapon/calendar day

(f) round/weapon/weapon firing day

(g) round/weapon/unit firing day

etc.

Data are categorized by type of mission, intensity, and terrain. Losses are also reported.

We extracted this data for the M16 Rifle for all available months. This was from April 1967 to February 1969.

## CHAPTER II

## ANALYSIS AT NICP LEVEL

### 2.1 Program Factors

a. Density - Forecasts of M16 Rifle density in Vietnam* for January 1967 through February 1969 are portrayed in figure 2.1.1. These numbers were extracted from the DA-1322 reports. Figures 2.1.2 and 2.1.3 are plots of the actual number of rifles in Vietnam that were fired** in each month by all units, and combat units only, respectively.

Inspection of figures 2.1.1 and 2.1.2 reveals that forecasts of density were not very good. Forecasts were not too bad before June 1968 since the patterns for that period are similar (slopes differ because the scales differ). However, after June 1968 a further buildup in rifles was expected to continue. Instead, a halt in the buildup occurred.

Inspection of figures 2.1.2 and 2.1.3 reveals that the patterns are the same. A time series plot made for density in hands of non-combat units was also the same. This indicated that a finer breakdown of density would not help in identifying what relationship exists between demand and density. Put in another way, this indicated that the information about the actual density at a theater level is all that is needed to determine if density has an identifiable effect on demand at the theater level. Restricting density data to weapons that intuitively are more likely to actually affect demand will not better identify the actual relationship between density and demand that might exist. For this reason comparisons of the patterns of density and demand will be made for figure 2.1.2 only. The pattern (dotted line) is a RAMP which tapers off in June 1968. The pattern is the assumed true average of the variable (density in this case).

Not all curves examined have a ramp characteristic. Density patterns of some major units (divisions, brigades, regiments, etc.) comprising the composite shape of figures 2.1.2 and 2.1.3 are stationary (constant). One example is shown in figure 2.1.4. The other example shown is stationary for the most part. Unfortunately these cannot be compared to the corresponding demand patterns because demand data at this level (excluding that in Chapter III) are not available.

b. Round Expenditure - The forecasts in DA-1322 reports differ in every monthly report. This makes a time series of this data impossible to plot. However, a plot of the forecasts made in December of 1966, 1967 and 1968 (extracts from December reports) was made and is shown as figure 2.1.5.

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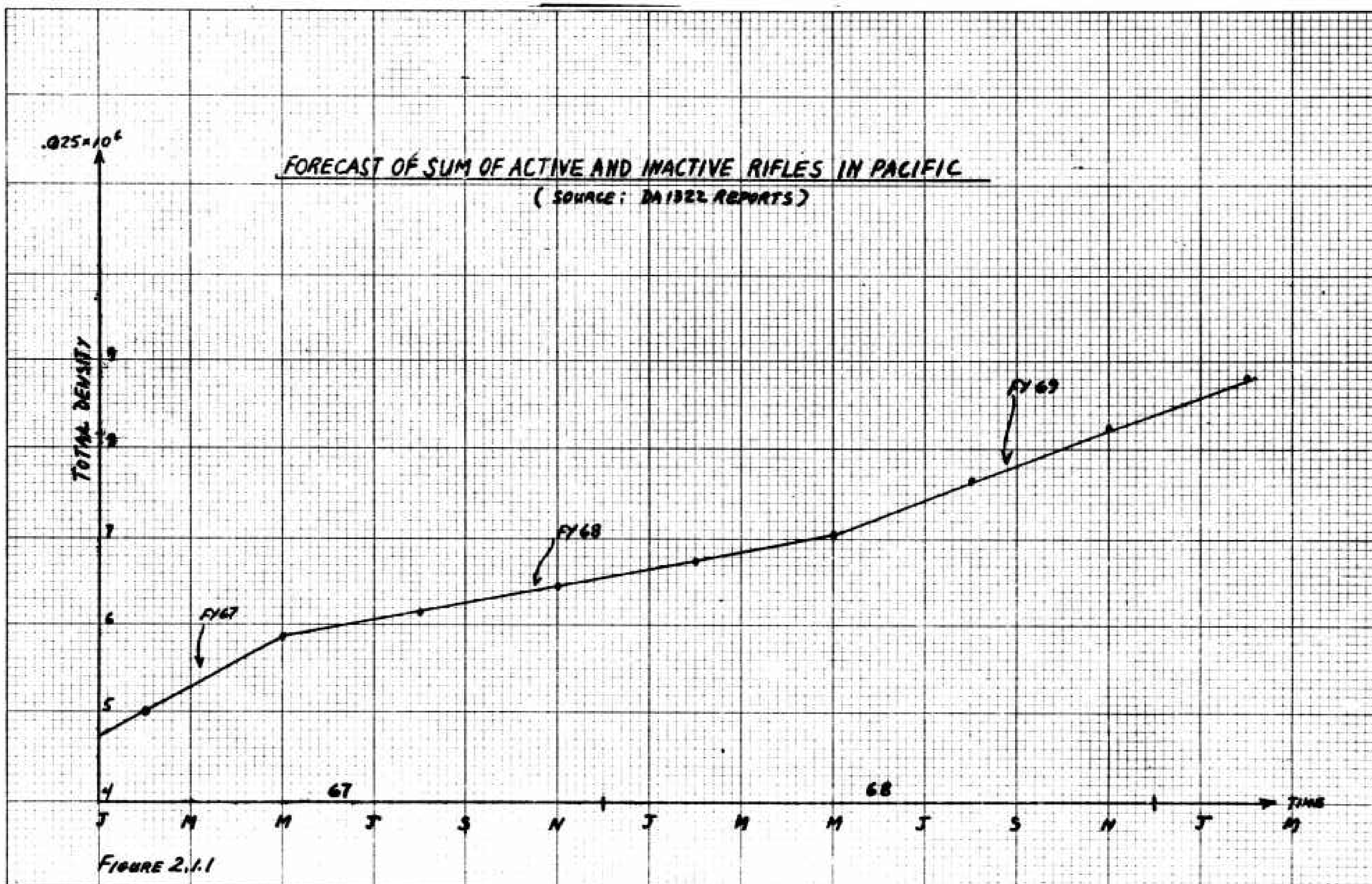
* The forecasts are actually for rifles in South East Asia.

** Presumably all units in Vietnam are reporting every activity, no matter how slight, as agreed under the COLED-V arrangement.



FORECAST OF SUM OF ACTIVE AND INACTIVE RIFLES IN PACIFIC
( SOURCE: DA1322 REPORTS )
.025×10⁶
TOTAL DENSITY
4
5
6
7
8
9
FY67
FY68
FY69
67
68
TIME
J
M
M
J
S
N
J
M
M
J
S
N
J
M


Figure 2.1.1

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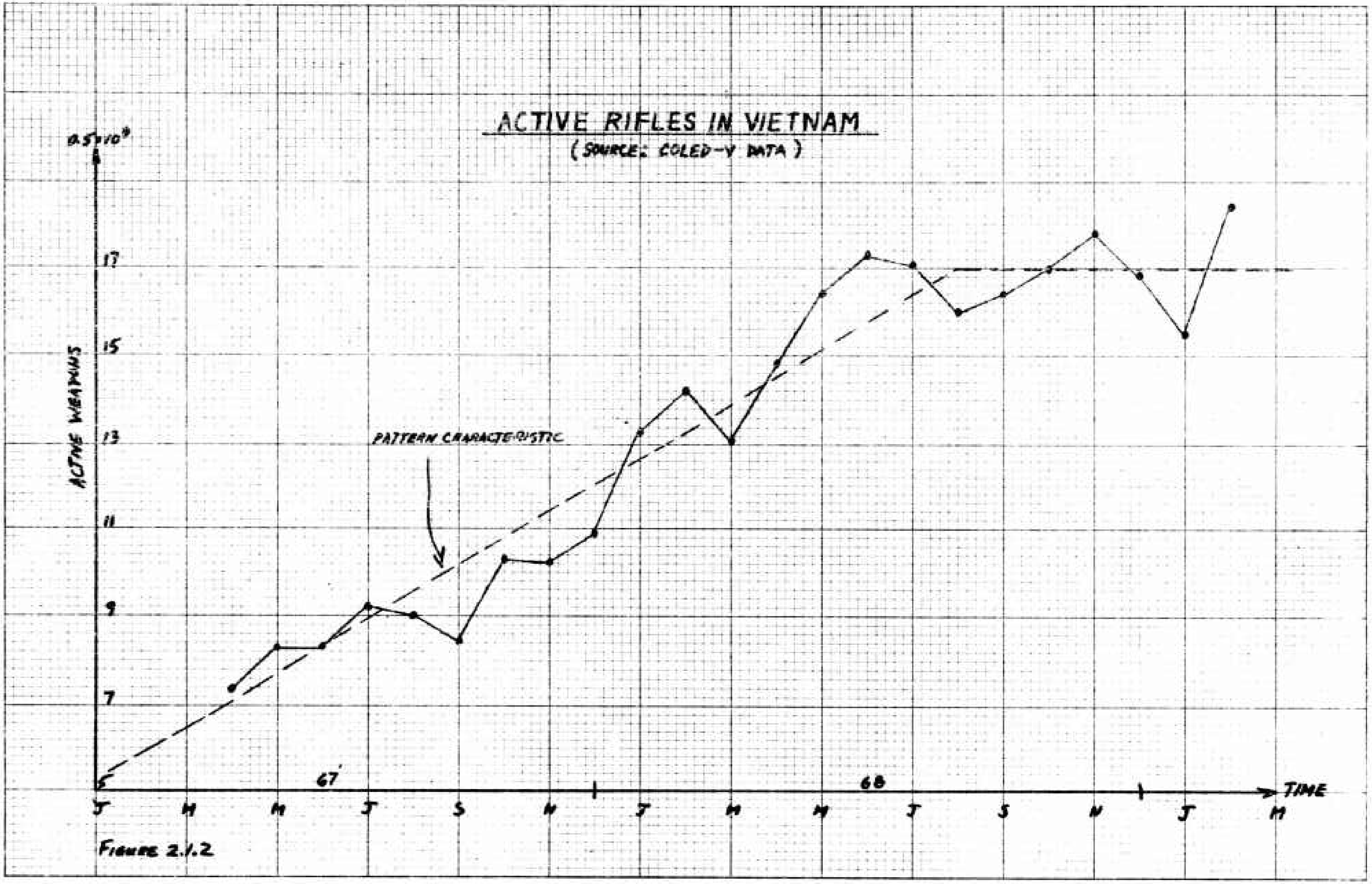


Figure 2.1.2

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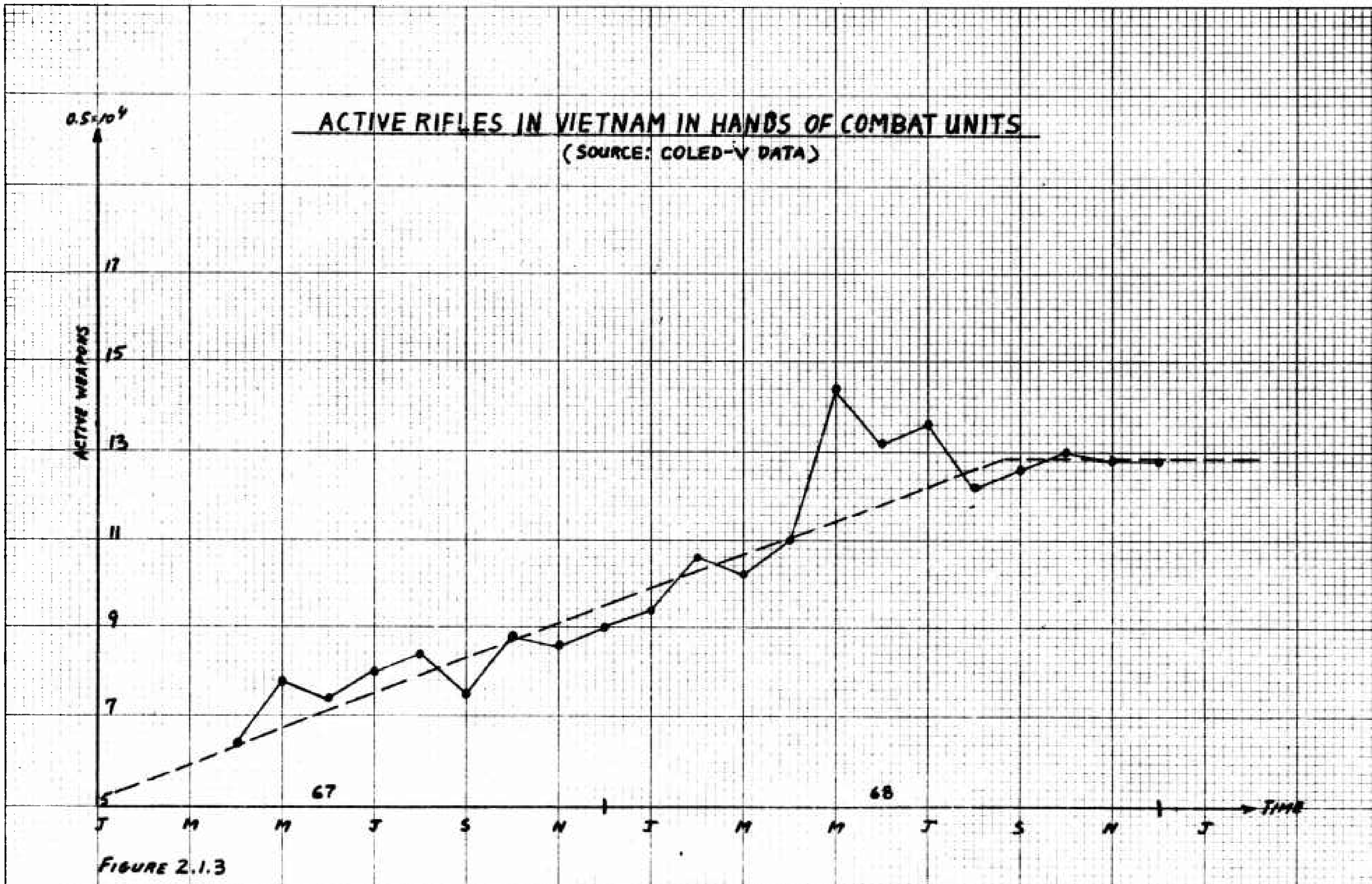


FIGURE 2.1.3

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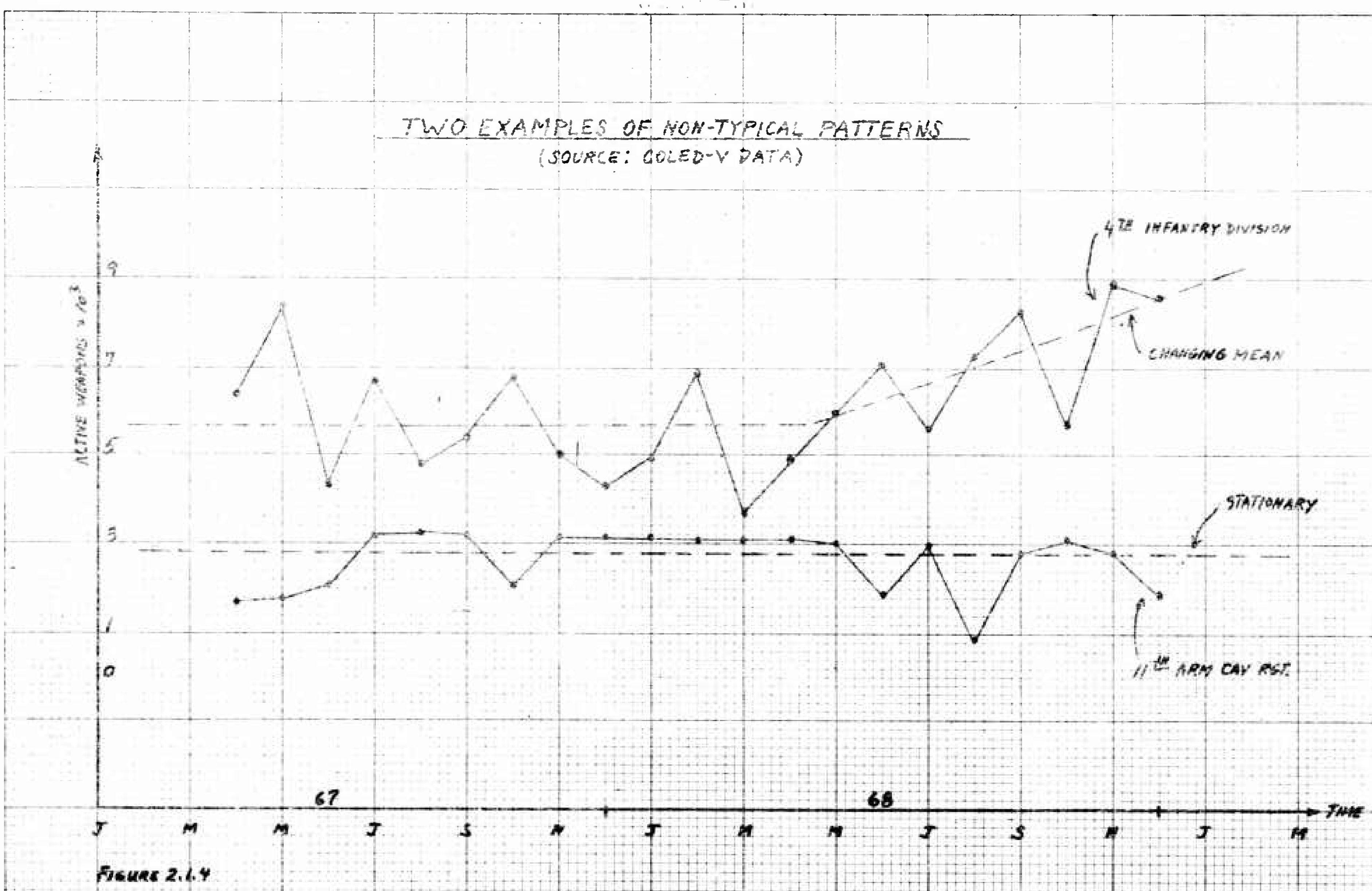


FIGURE 2.1.4

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These round expenditure forecasts for Vietnam clearly show that a heavily increasing activity was expected in all of 1967, a steady and much lower activity in 1968 and a steady but still lesser activity in 1969. These do not compare well with the actual round expenditure of figure 2.1.6 which is a plot of round expenditure for Vietnam reported under the COLED-V system. This plot shows that the average round expenditure remained constant until December 1967 (Tet Offensive) at which time an increase occurred. The changeover was very quick and the average expenditure remained constant (and at the new level) after the changeover. This pattern is thus characterized by a STEP.

Figure 2.1.6 on round expenditure was decomposed into three classes with several elements in each class. These were -

(1) type of units
  (a) combat
  (b) non-combat
(2) type of mission
  (a) search and destroy
  (b) clear and secure
  (c) security
  (d) base and defense
  (e) harass
  (f) combat support
  (g) training
  (h) all other
(3) type of terrain
  (a) jungle
  (b) coastal
  (c) delta
  (d) open

This analysis indicated that all elements of all classes had round expenditure patterns that were basically the same as the composite pattern of figure 2.1.6. This indicated that actual expenditure of rounds at the theater level are all the data needed to determine if demand at theater level and round expenditure are correlated.

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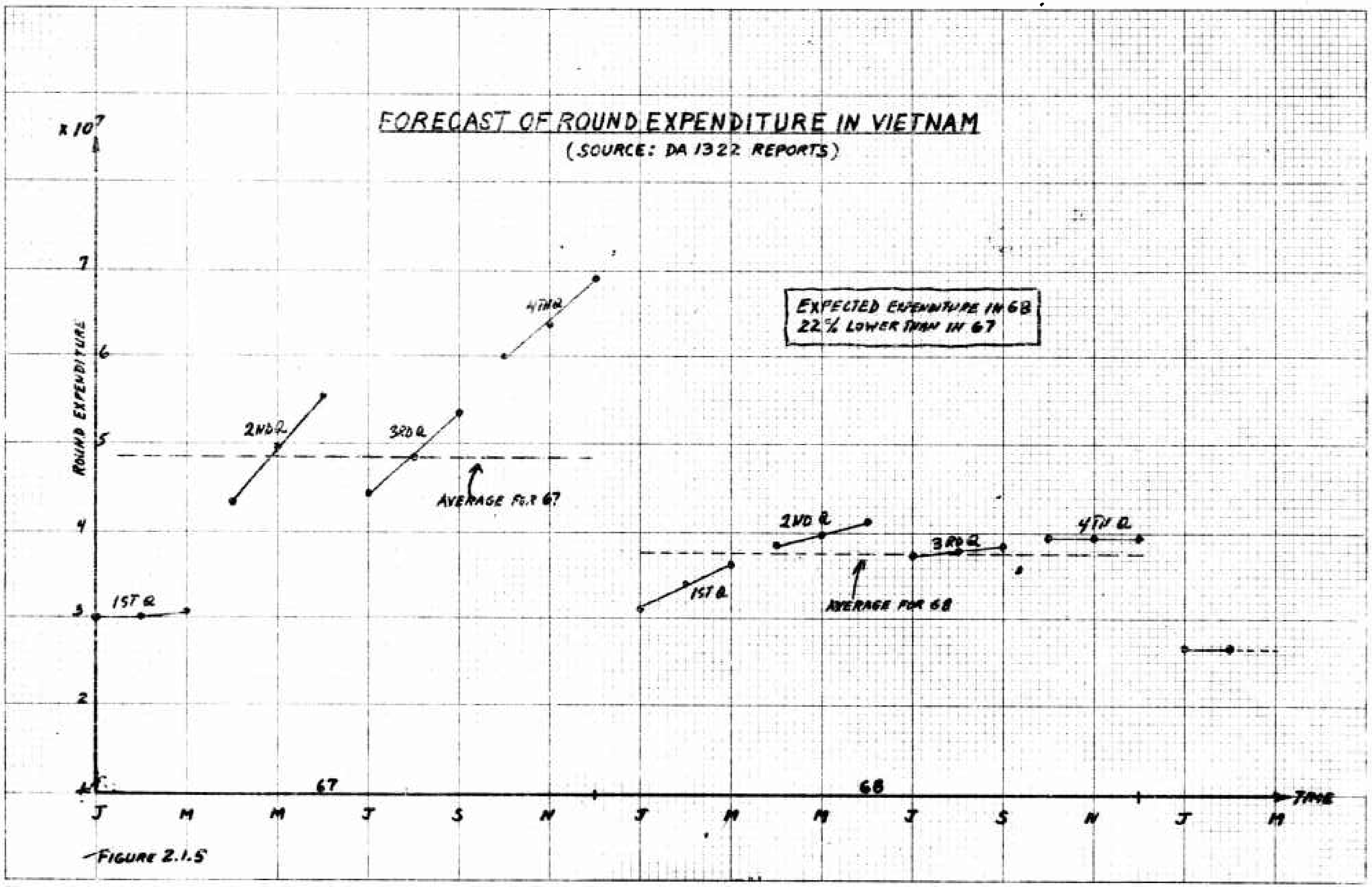


FIGURE 2.1.5

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Although patterns were similar, the amount of round expenditure varied considerably among the various missions or among the various types of terrain. If the number of missions can be predicted accurately beforehand by type of mission and terrain then this information might be used in forecasting round expenditure.

2.2. (U) Demand

a. Line Items - There was no predominant demand pattern for the individual items. Almost anything could be found in a pattern. Stationary patterns superimposed by ramps, steps, and impulses in every combination were observed. Two examples are shown in figures 2.2.1 and 2.2.2.

It was clear from these patterns that a uniform program factor-demand relationship could not be found from these individual plots. The plots suggested that if program factors must be used, different program data and different methods should be employed for each item. This, of course, is not only infeasible, but unrealiable as well because the patterns are subject to change because of their tenuous nature. The method of approach suggested was to look for a pattern in an aggregate plot of these items and apply the relationship found, if any, to all the items.

b. Aggregate Dollar Demand - Figure 2.2.3 displays the monthly dollar value of demands ($ demand) for the aggregate of all items listed in Appendix B. The time series clearly indicates that a STEP occurred in December 1967, and at the same time the magnitude of noise increased immensely. This noise persisted but the STEP remained.

To determine if this pattern was caused primarily by some particular group of items, several groups were formed and analyzed. These groups were accessories, cleaning parts, configuration parts, and the rest were placed in a category of integral rifle parts. Also to make certain that the pattern was not due primarily to a few high unit price items,all parts with unit price greater than three dollars were analyzed as a group. All groups are self-explanatory except for the configuration parts. These were items which underwent some configuration change and included buffer assembly (replaced by improved ones), bolt assembly, bolt carrier, and flash suppressor. The last three were chrome plated.

The analyses consisted of plots for each group as well as plots that excluded from the composite aggregation (figure 2.2.3) each of these groups separately, and two at a time when appropriate. The results were somewhat interesting. Except for accessories, the plots by group were basically similar to the aggregate plot of figure 2.2.3. The only observed difference was that for integral parts (including high unit priced items) the step occurred three months later, i.e., March 1968. The plot is figure 2.2.6.

The plot of the accessories group is figure 2.2.4. It shows that the average dollar demand for accessories tends to be constant in the long run. The dollar value of demand in 1968 was somewhat larger than in 1967 but the difference is small. Items placed in this group were the 20 round magazine, gun sling, bipod, and bipod case. The accessory plot without the 20 round magazine did not change.

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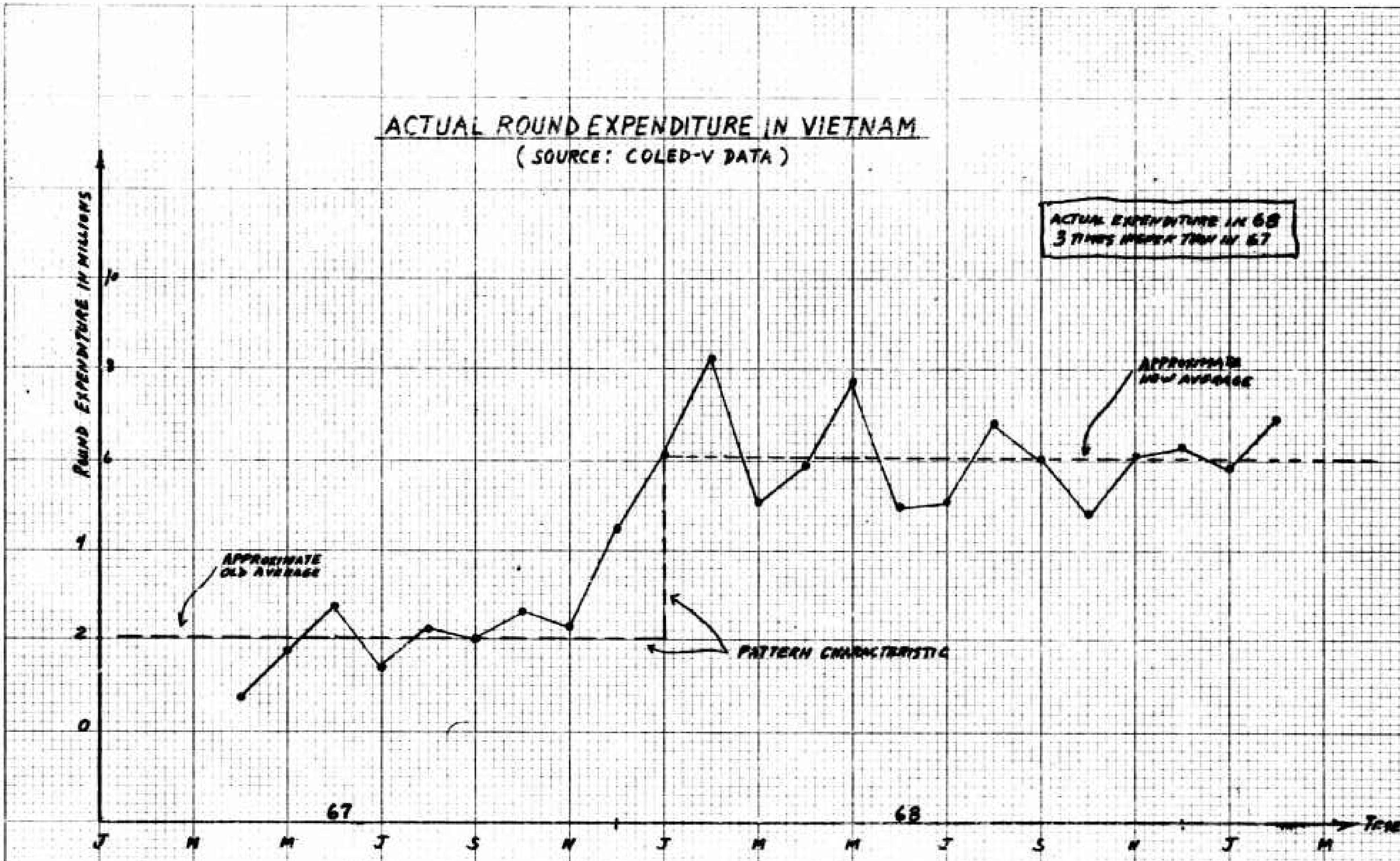


FIGURE 2.1.6

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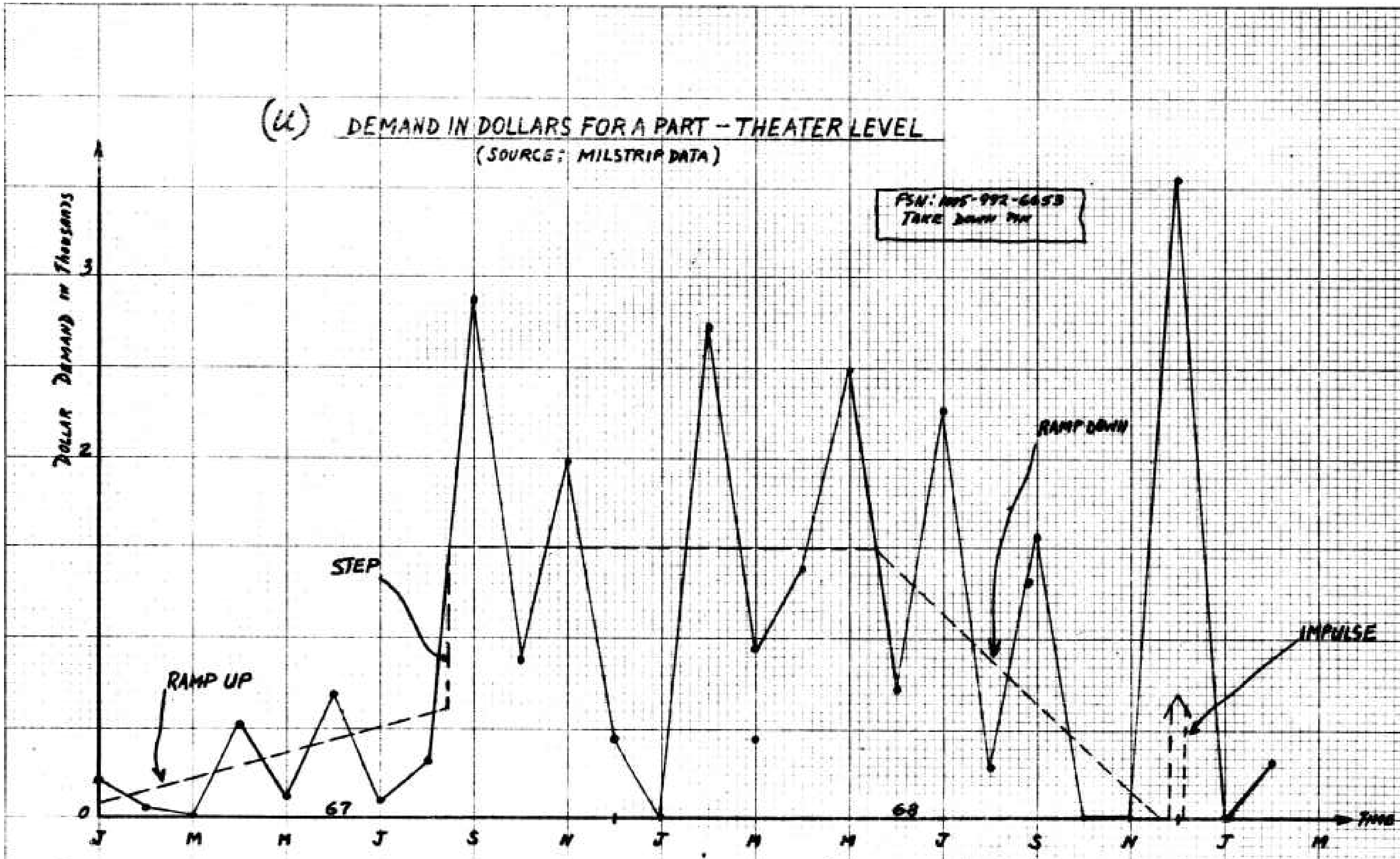

(u) DEMAND IN DOLLARS FOR A PART - THEATER LEVEL
(SOURCE: MILSTRIP DATA)
DOLLAR DEMAND IN THOUSANDS
0
2
3
J
M
M
J
S
N
J
M
M
J
S
N
J
M
67
68
TIME
RAMP UP
STEP
RAMP DOWN
IMPULSE


FIGURE 2.2.1

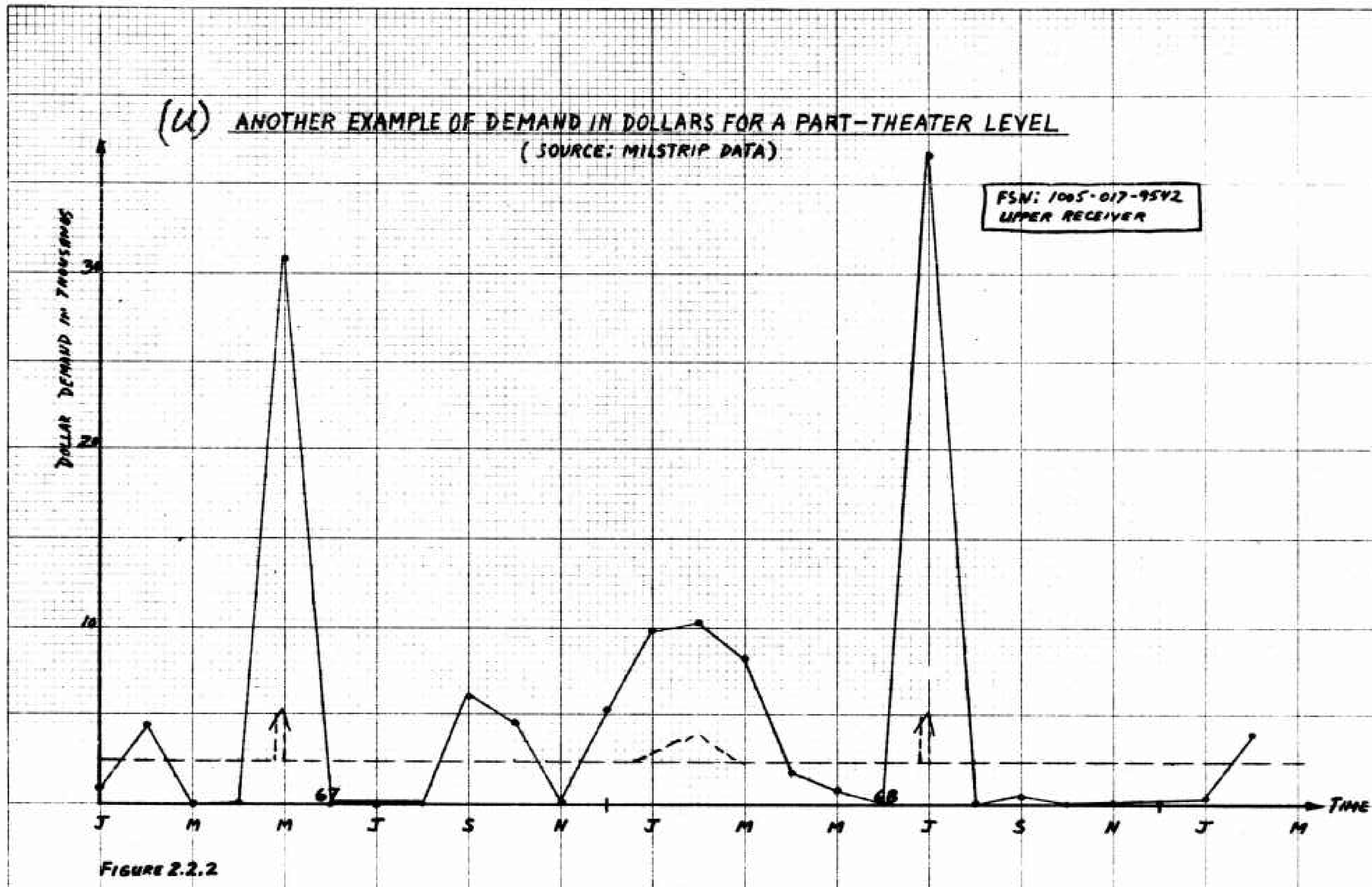
(U) ANOTHER EXAMPLE OF DEMAND IN DOLLARS FOR A PART-THEATER LEVEL
(SOURCE: MILSTRIP DATA)
FSN: 1005-017-9542
UPPER RECEIVER
DOLLAR DEMAND IN THOUSANDS
30
20
10
67
68
J M M J S N J M M J S N J M
TIME

FIGURE 2.2.2

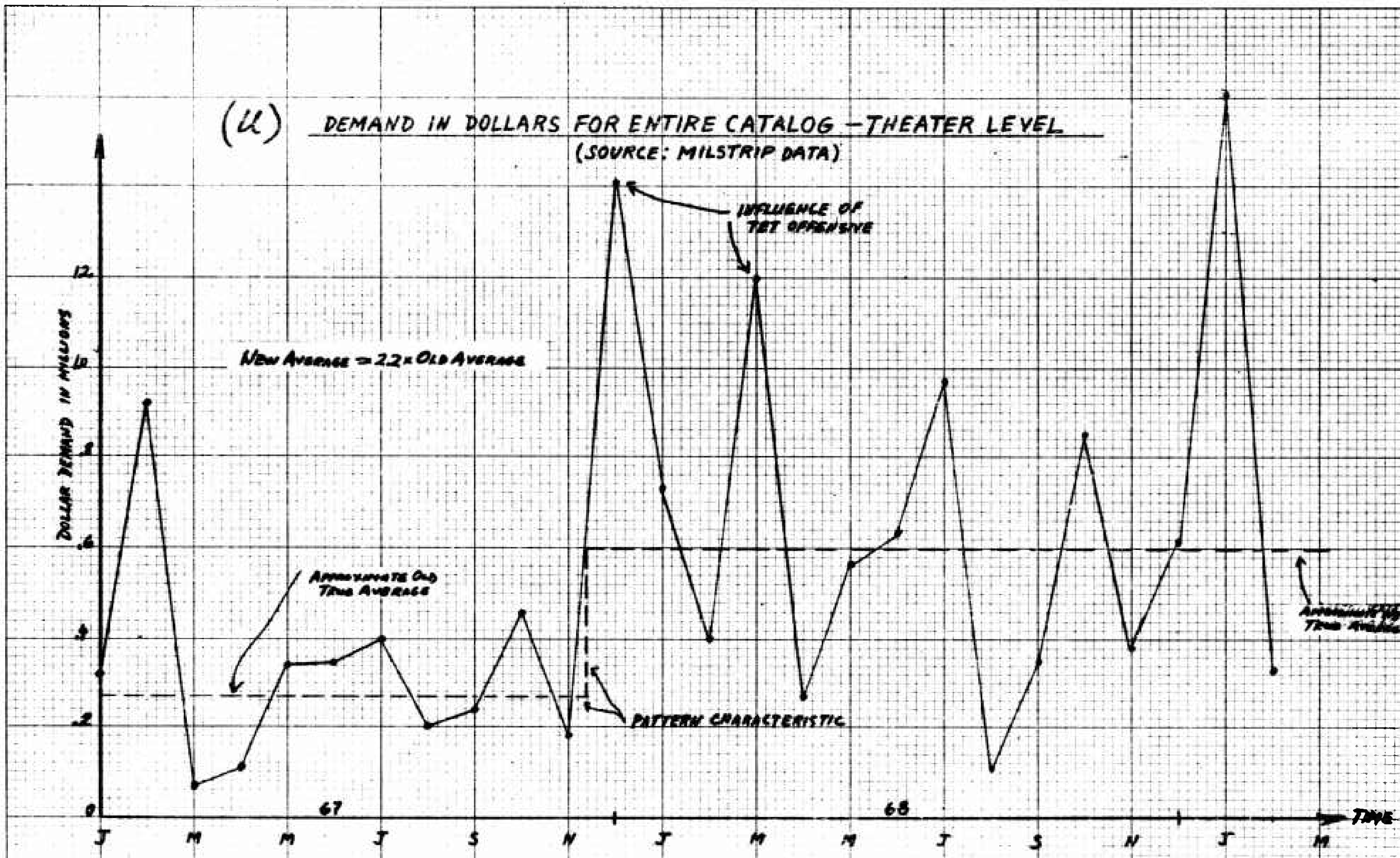
(U) DEMAND IN DOLLARS FOR ENTIRE CATALOG — THEATER LEVEL
(SOURCE: MILSTRIP DATA)
INFLUENCE OF TET OFFENSIVE
NEW AVERAGE = 2.2 x OLD AVERAGE
APPROXIMATE OLD TRUE AVERAGE
PATTERN CHARACTERISTIC
APPROXIMATE NEW TRUE AVERAGE
DOLLAR DEMAND IN MILLIONS
12
10
.8
.6
.4
.2
0
67
68
J M M J S N J M M J S N J M
TIME

FIGURE 2.2.3

(u) DEMAND IN DOLLARS FOR ALL ACCESSORY PARTS - THEATER LEVEL

(SOURCE: MILSTRIP DATA)

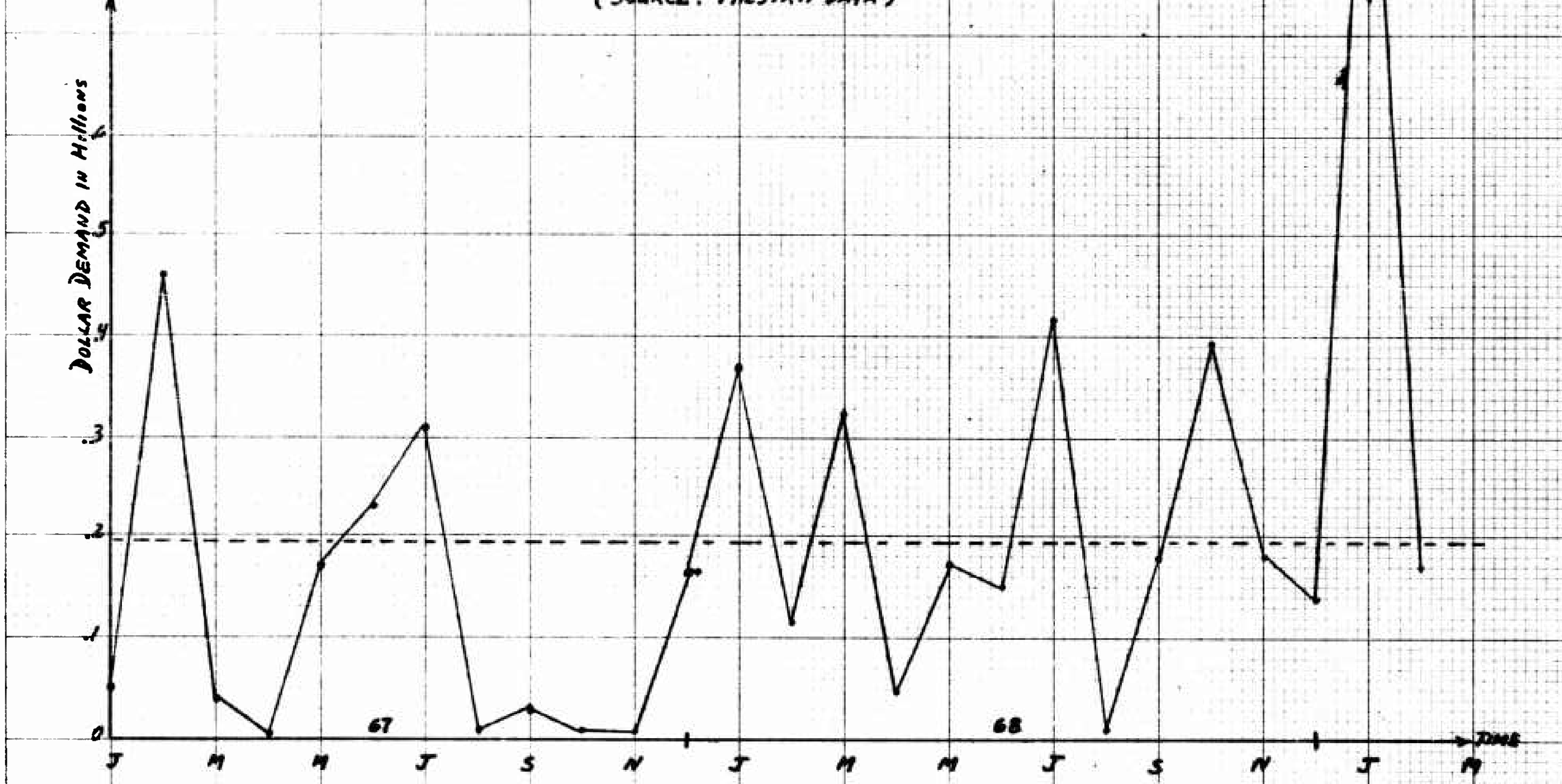


Figure 2.2.4

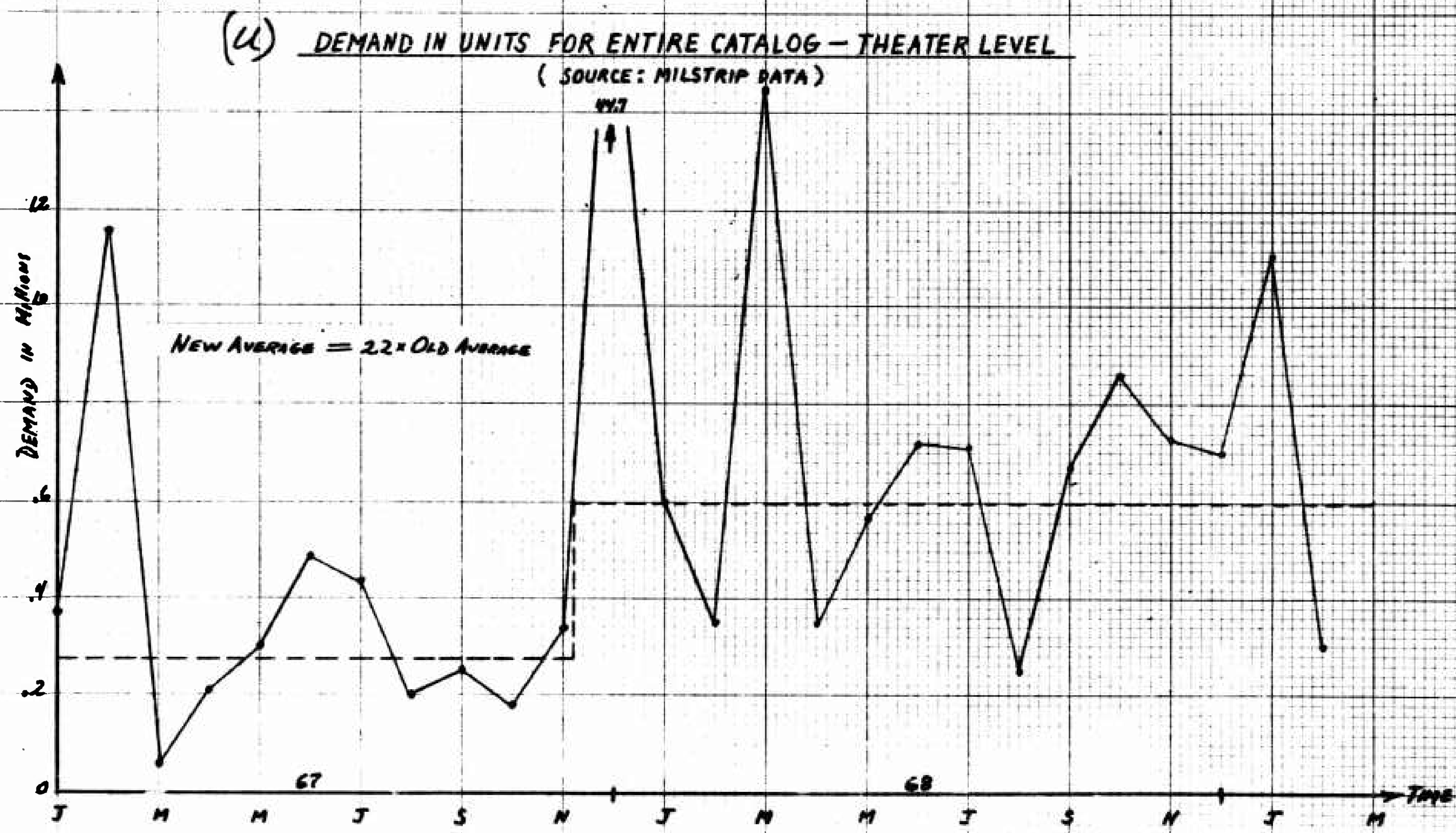
(U) DEMAND IN UNITS FOR ENTIRE CATALOG — THEATER LEVEL
( SOURCE: MILSTRIP DATA )
44.7
New Average = 2.2 × Old Average
DEMAND IN MILLIONS
1.2
1.0
.8
.6
.4
.2
0
J
M
M
J
S
N
J
M
M
J
S
N
J
M
67
68
TIME

FIGURE 2.2.5

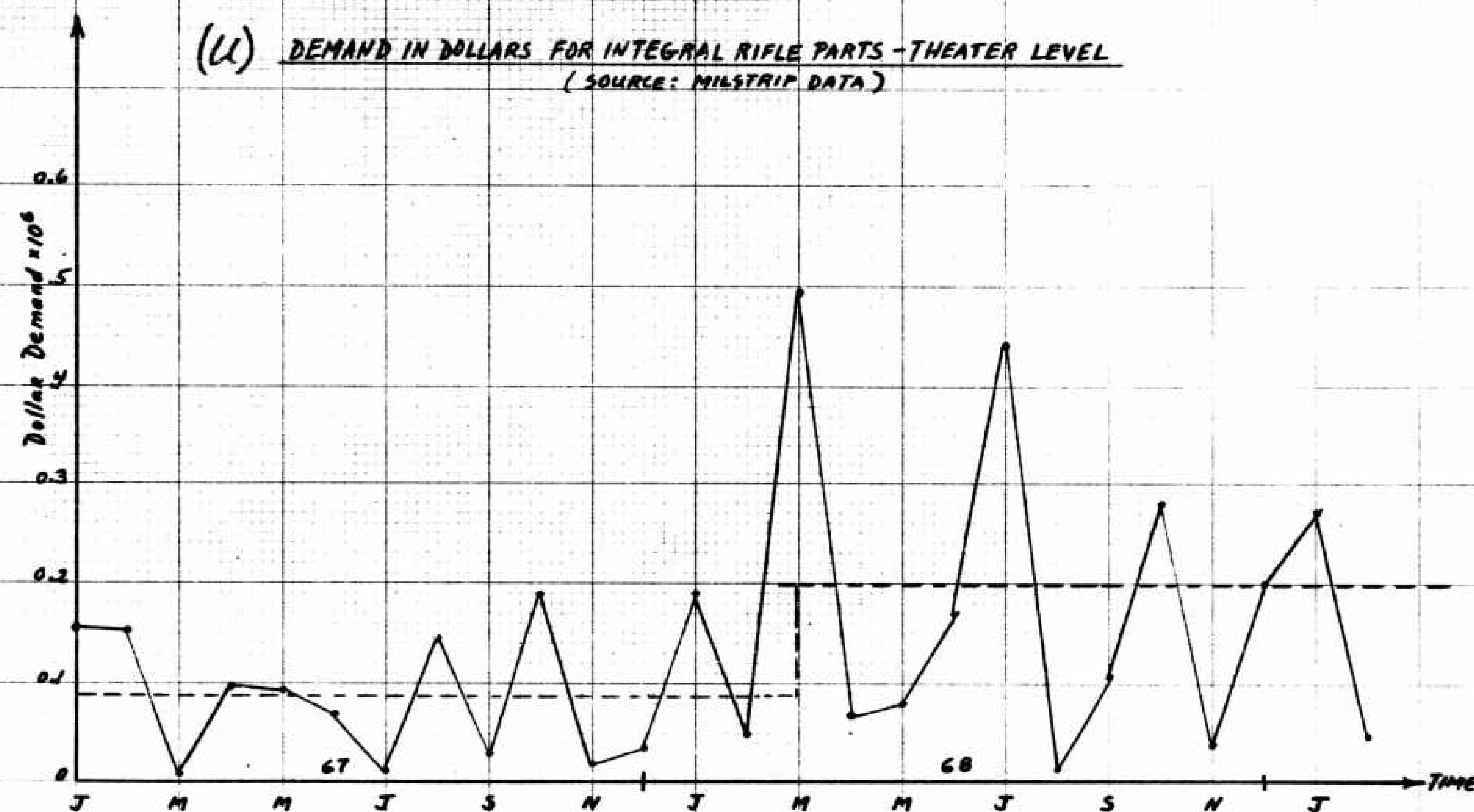
(U) DEMAND IN DOLLARS FOR INTEGRAL RIFLE PARTS - THEATER LEVEL
(SOURCE: MILSTRIP DATA)
Dollar Demand ×10⁶
0.6
.5
.4
0.3
0.2
0.1
0
67
68
J
M
M
J
S
N
J
M
M
J
S
N
J
TIME

FIGURE 2.7.6

These results are significant. They suggest that the best forecast base may not only differ for these classes but that the time for changing the base might also differ among the classes. For this reason it would make sense to manage these items by classes.

c. Aggregate Demand - Figure 2.2.5 is the version of figure 2.2.3 for aggregate demand in units. This figure in every respect resembles figure 2.2.3. Nothing can be learned from analysis of this curve that could not be learned from analysis of the aggregate dollar demand. Therefore, further analysis of aggregate demand in units was not conducted.

## 2.3 (U) Dollar Demand - Program Factor Relationships

Various possibilities could be examined in this section. However, it will suffice to limit the analysis to figures 2.1.2, 2.1.6, 2.2.3 and 2.2.4. As was already noted nothing more can be learned by looking at round expenditures by mission, terrain, etc., or density for specific units, e.g. combat. Analysis of figure 2.2.3 is automatically analysis of all classes as well (excluding accessories) if the three month lag for integral parts is borne in mind.

a. Dollar Demand/Density - The RAMP characteristic to figure 2.1.2 is not present in figure 2.2.3 nor 2.2.4. Although $ demand for the catalog is much greater in 1968 than it is in 1967, as is true for density, it cannot be concluded that the two are related. For accessories it is clear that $ demand is not correlated with density but tends to hold a constant average value.

b. Dollar Demand/Rounds Expended - Comparing figure 2.1.6 with figure 2.2.4 reveals that $ demand for accessories and round expenditure are not correlated. Comparing figure 2.1.6 to figure 2.2.3 shows that dollar demand for the catalog is correlated with rounds although the correlation is not automorphic, i.e., changes in the magnitudes of round expenditure and $ demand are not proportional. This is evident in the size of the step for round expenditure and $ demand. That the two are correlated cannot be deduced by comparing $ demand and round expenditure values in corresponding months. This is especially clear in the months immediately following the occurrence of the steps. However, when all the noise is disregarded the correlation is apparent simply because the patterns of $ demand and round expenditure are stationary in the same interval, step up at about the same point in time, and remain stationary at the higher level from then on. Since the steps occurred at about the same time, it is clear that $ demand for catalog does not lag round expenditure.

Now recalling that the patterns of cleaning parts is the same as that of the catalog, it becomes apparent that $ demand for cleaning parts and round expenditure are correlated and have zero lag. Because of the 3 month lag in the pattern of integral rifle parts, it is also apparent that $ demand for integral parts is correlated with round expenditure, but lags rounds by 3 months.

# CHAPTER III

## ANALYSIS AT DSU LEVEL

The total dollar value of demand for three (non-combat supporting) of the DSU's combined was only 4% of the dollar demand of the single combat supporting DSU - the 709th maintenance battalion. Regardless of the cause of this - the three DSU's are either naturally inactive or the data recorded on the ledger sheets were incomplete - any program factor-demand correlation found would be comparatively insignificant, if not misleading. Put another way, whatever is found for the 709th DSU can be taken to be representative of that level since the non-active elements do not contribute sufficiently to supply control problems at the NICP.

What was noted about round expenditure by various missions and terrain at the NICP level applies to the 709th DSU as well. The applicable density data is that in the hands of the 9th Infantry Division since this division is supported by the 709th. These data are only available from the COLED-V reports so that forecast accuracy of density at this level cannot be determined.

Plots of demand for individual items generally had an impulse in December 1967 or January 1968. Aside from the fact that the individual plots exhibit an impulse, they are otherwise quite random and highly variable. Figure 3.1 is a typical plot. Aggregation of parts by units and dollars again showed that aggregation by units need not be considered.

Figures 3.2, 3.3, and 3.4 are plots, respectively, of density, round expenditure, and dollar demand for the whole catalog. It is clear that the RAMP for density and STEP for rounds and $ demand that were seen in plots at NICP level persist here. Using the same type of reasoning as before, it is clear that $ demand is not correlated with rifle density but is correlated with round expenditure. The degree of correlation is impossible to determine.*

What was said about classes is no longer valid here. $ demand of integral rifle parts is still correlated with rounds but does not lag rounds in any way. In fact, it even appears to anticipate round increase although this is not really evident since round expenditure did increase somewhat in December 1967. The much larger increase for dollar value of demand is probably an overreaction to the increase in round expenditure. Cleaning equipment, however, is no longer correlated but accessories appear to be. These results cannot take precedence over those for the NICP level since they represent merely one observation used in the NICP level analysis. But they support the general conclusion of the earlier chapter, namely, that it makes sense to manage by these classes. Figures 3.5, 3.6, and 3.7 are plots of the $ demand for integral rifle parts, cleaning parts, and accessory parts, respectively.

*Statistical techniques cannot be used for reasons stated in the summary.

## (U) TYPICAL DEMAND PATTERN FOR A PART—DSU LEVEL

(SOURCE: NCR 500 DATA)

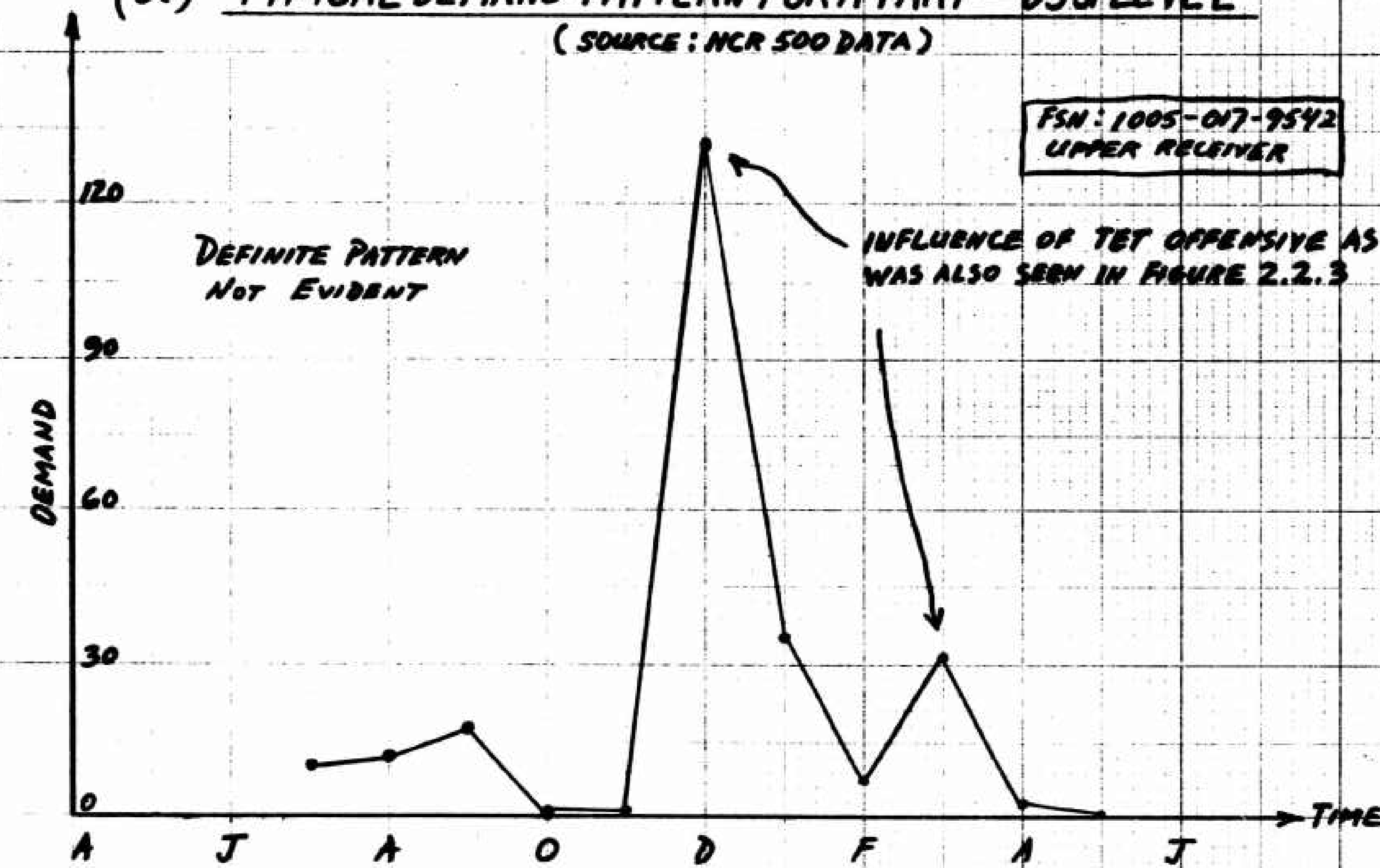


FIGURE 3.1

**CONFIDENTIAL**

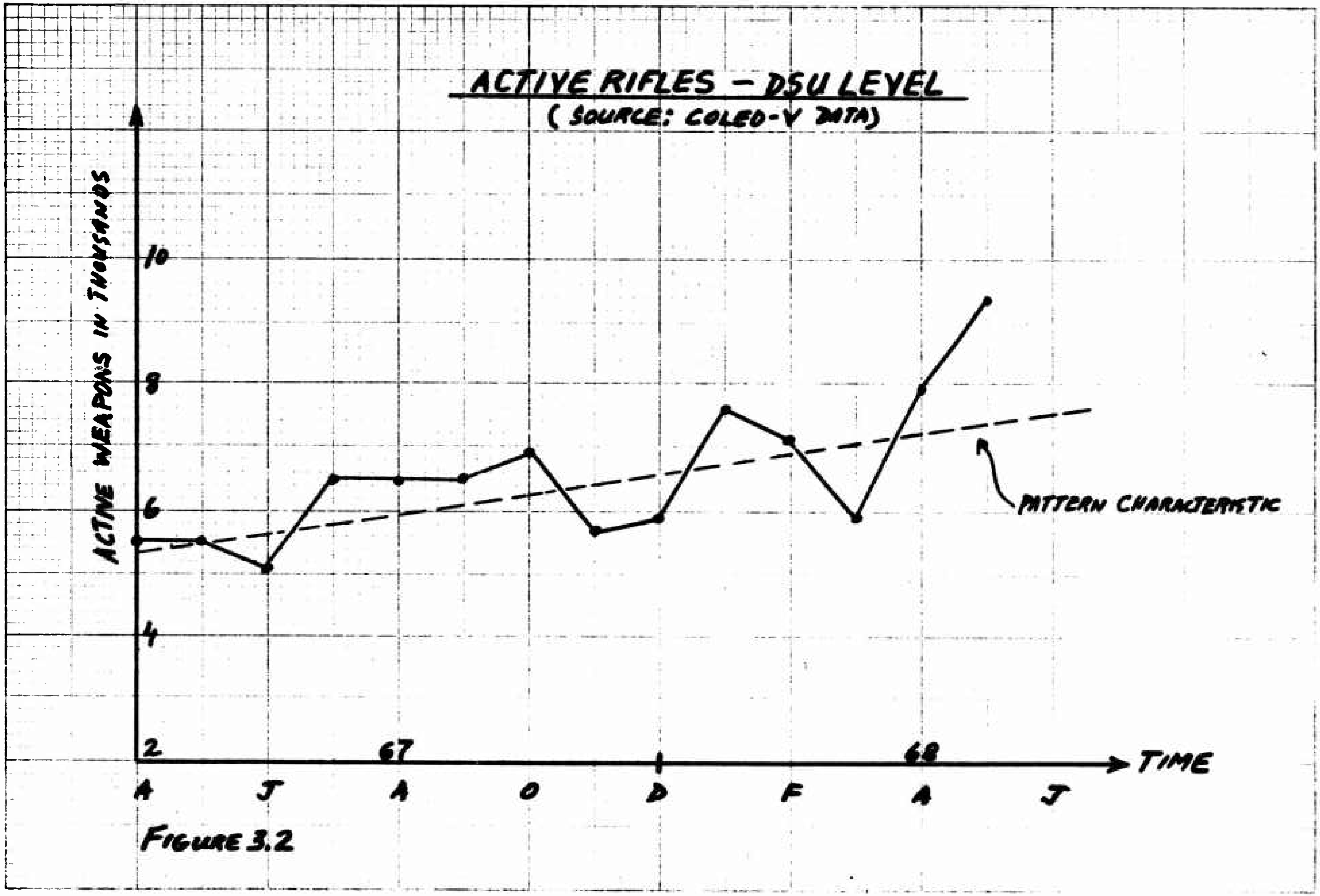


FIGURE 3.2

**CONFIDENTIAL**

CONFIDENTIAL

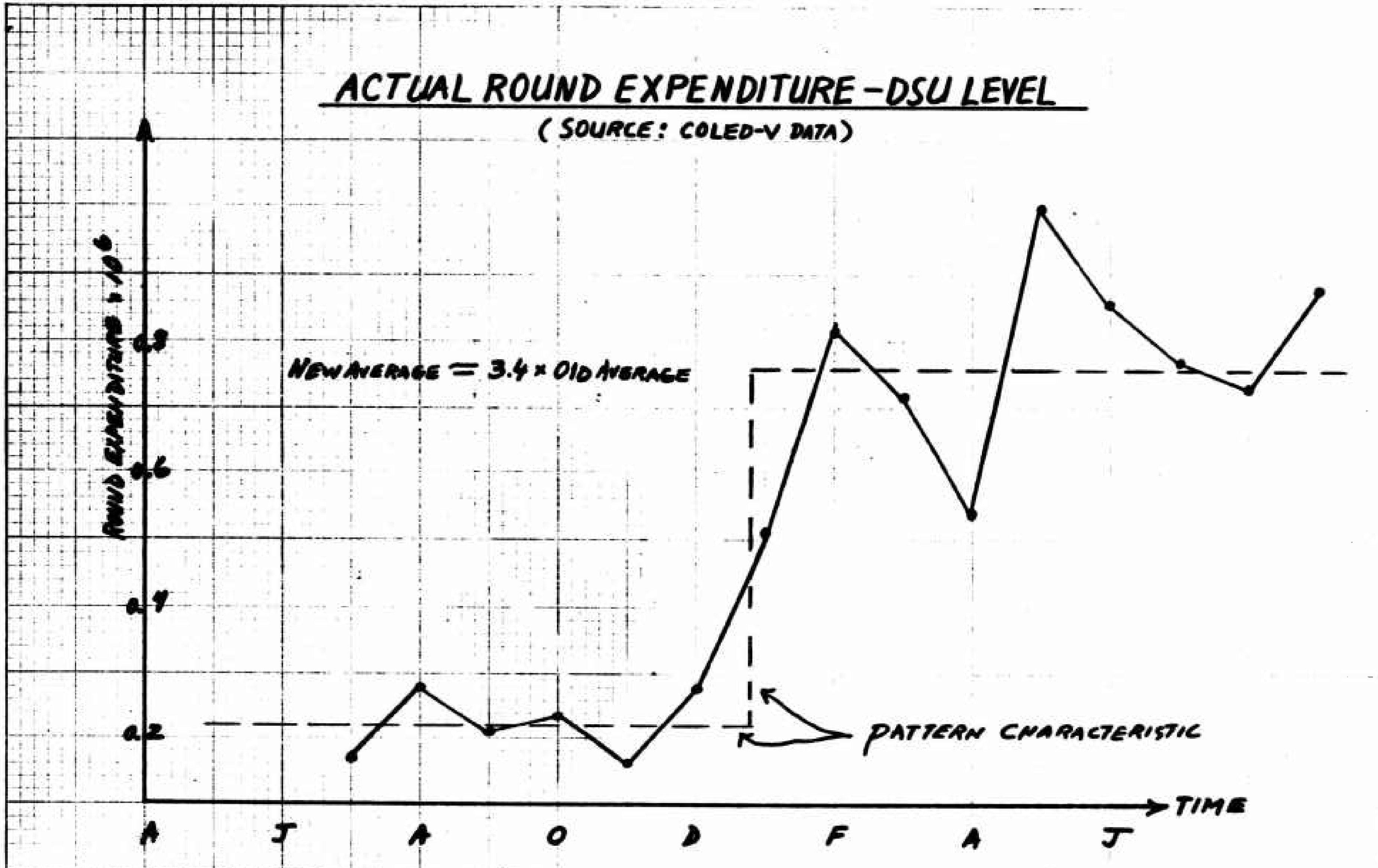


FIGURE 3.3

CONFIDENTIAL

## (u) DOLLAR VALUE OF DEMAND FOR ENTIRE CATALOG — DSU LEVEL

( SOURCE: NCR 500 DATA )

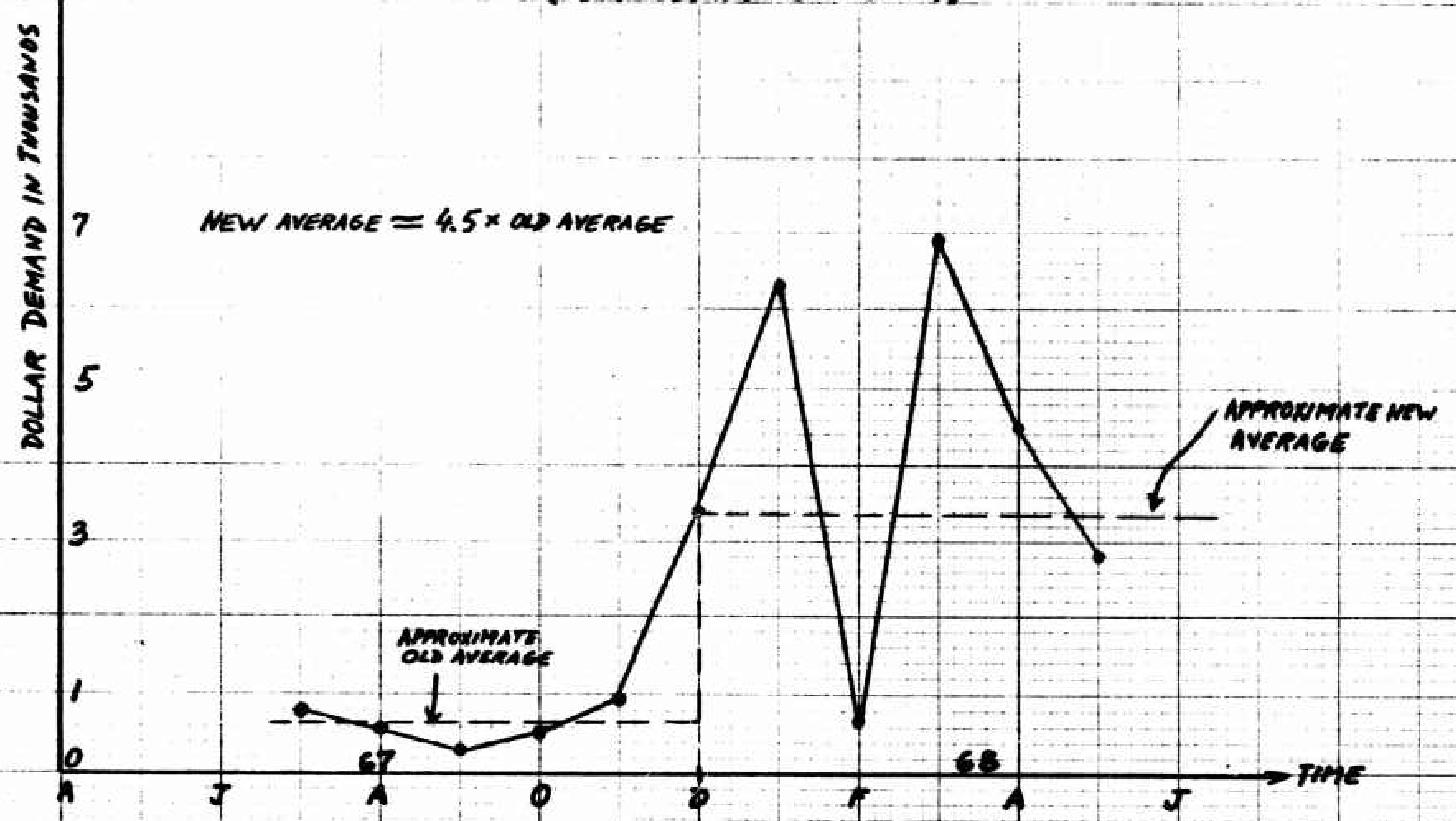


FIGURE 3.4

(U) DOLLAR VALUE OF DEMAND FOR INTEGRAL RIFLE PARTS—DSU LEVEL

(SOURCE: NCR500 DATA)

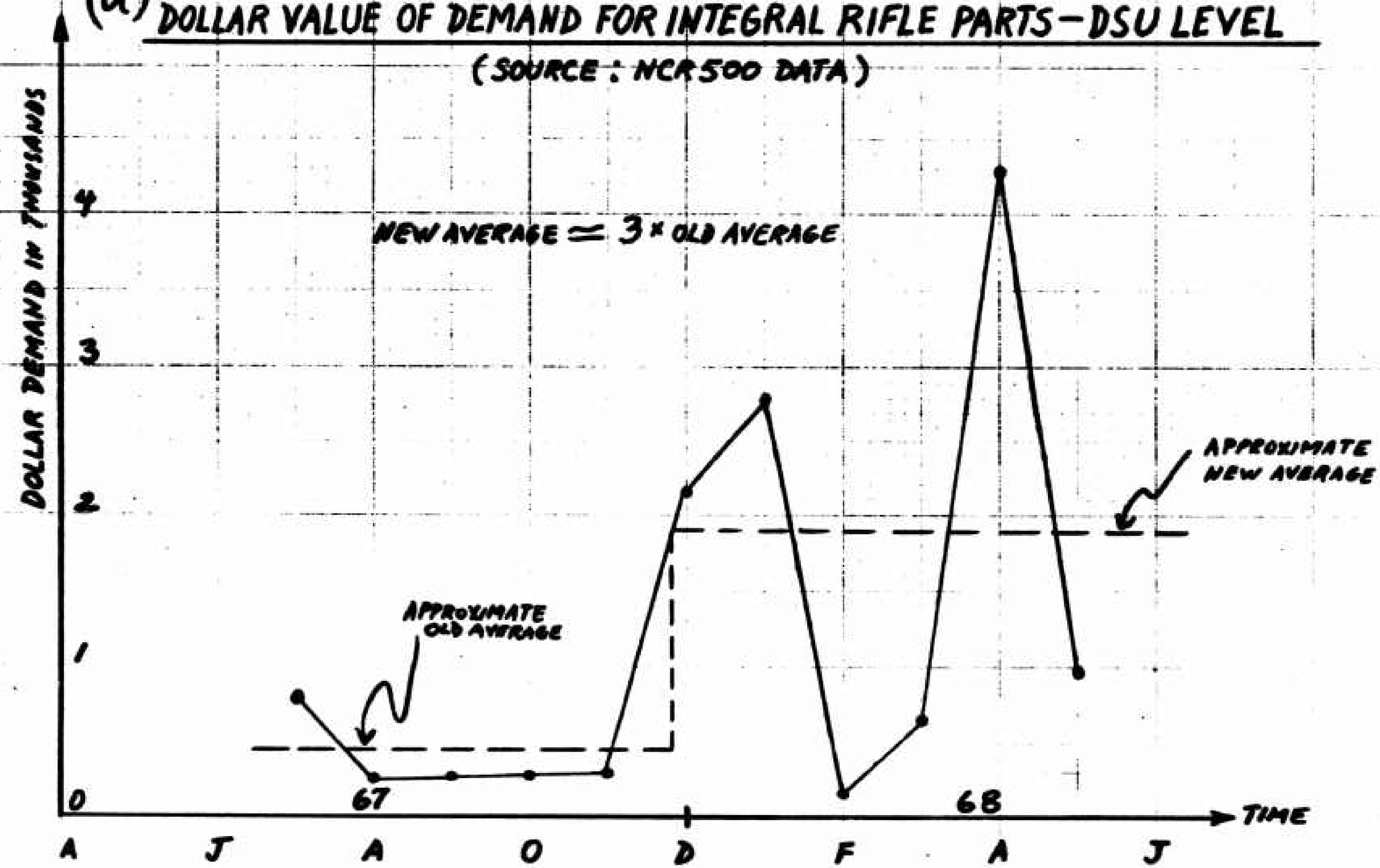


FIGURE 3.5

(U) DOLLAR VALUE OF DEMANDS FOR CLEANING PARTS—DSU LEVEL

(SOURCE: NCR 500 DATA)

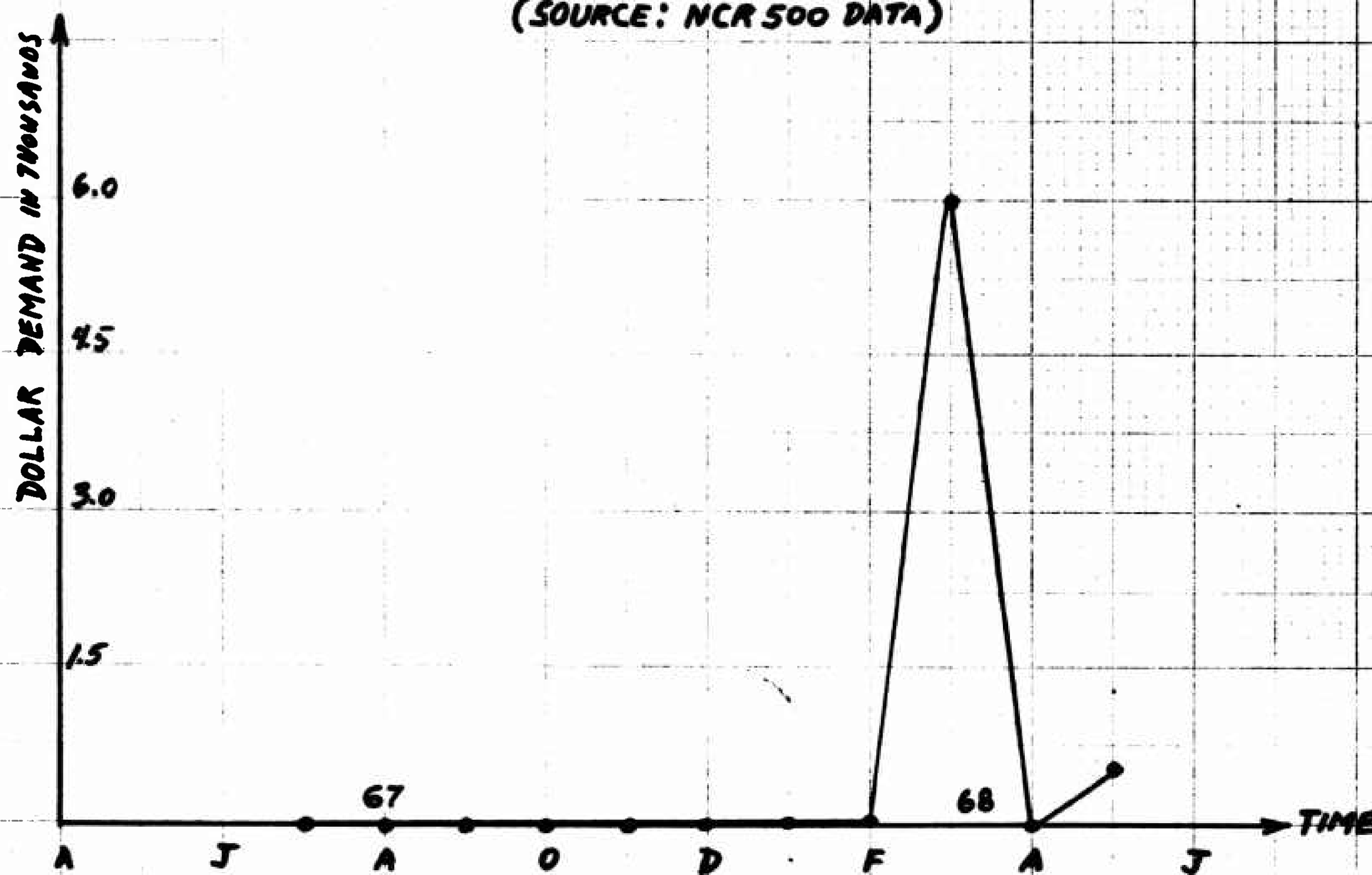


FIGURE 3.6

(U) DOLLAR VALUE OF DEMAND FOR ACCESSORY PARTS–DSU LEVEL

(SOURCE: NCR 500 DATA)

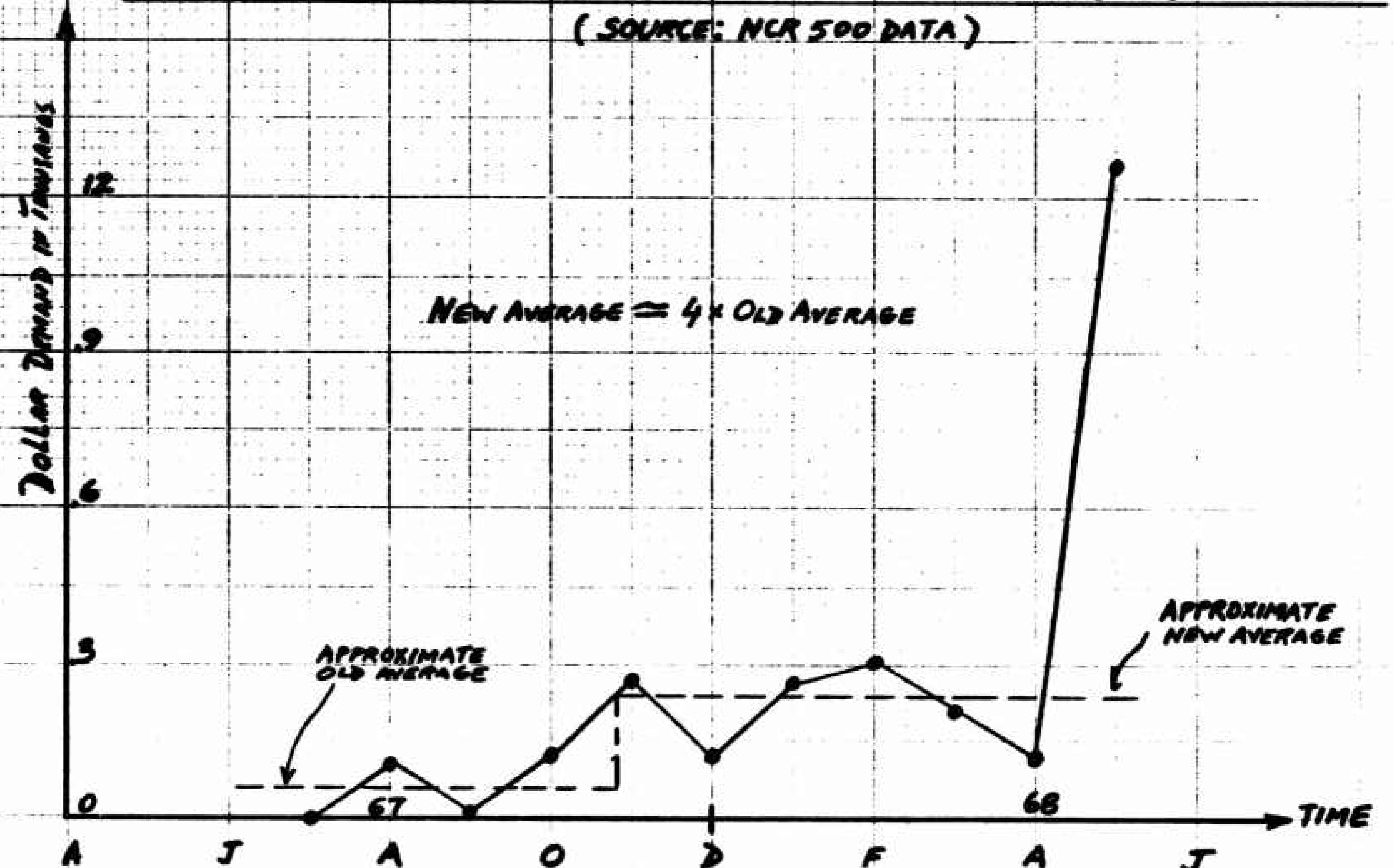


Figure 3.7

## CHAPTER IV

## (U) SIGNIFICANCE OF RESULTS FOR MANAGEMENT

The results indicate that management of the items studied is a difficult task that requires a great deal of effort to achieve reasonable long-term forecast accuracy. Consistent short-term accuracy is an unreasonable objective.

The difficulty of management is dramatically illustrated by citing a few examples. The demands for some parts of the M16 Rifle have been of incredible magnitude. In a single month about two million chamber brushes and about the same number of bore brushes were demanded. In another month nearly 500,000 patches were demanded. The large demands were not restricted to cleaning equipment alone. One month demands, for example, for spring actions, buffer retainer springs, buffer assemblies, barrel and sight assemblies, hand guards, and stock assemblies were in the hundreds of thousands each. The dollar value of these one month demands for the barrel and sight assembly and the stock assembly alone was about $500,000. The monthly demands cited for each of these items were at least one hundred times larger than the average demand for the item.

The correct path to achieving the objective of improved forecasts requires some changes in current procedures. The changes required are certainly feasible since these items are already intensively managed. They consist of keeping visual track of dollar demand, round expenditure, and weapon density since these elements are always subject to change.* In this way the correct forecast base and proper use of program factors can be determined before assets and needs are completely out of balance. The relationship found for dollar demand and round expenditure cannot be guaranteed to hold indefinitely. The same is true for the lack of a relationship for dollar demand and rifle density.

Whether or not these changes should be implemented depends on how good future forecasts of program factors will be. If they are not better than what was seen in this study, implementation should wait until a study has been initiated to improve program factor forecasting. If no such study can be sponsored, then program factors should not be used in forecasting demands for parts.

* This amounts to monitoring the relationship between dollar demand and program factors. Although monitoring might be programmed for a computer, manual monitor is preferred for numerous reasons. One good reason is that these items require intensive management.

## CHAPTER V

## (U) "ART" FORECASTING

The previous chapter suggests that the dollar value of demand, round expenditure, and weapon density be kept under surveillance and gives reasons for this. The implied method is to maintain updated time series for these variables. "Art" forecasting is synonymous with updating and analyzing these time series and then using the results in supply control. It assumes that sufficiently accurate forecasts of density and round expenditure are made available to the manager whenever he needs them. A description of "Art" forecasting follows: The time series required are for -

(1) dollar value of demand for cleaning parts of a weapon

(2) dollar value of demand for accessory parts of a weapon

(3) dollar value of demand for integral parts (all other)

(4) round expenditure (forecasted)

(5) weapon density (forecasted)

The basic unit of time in the time series is a month, i.e., monthly values of (1) through (5) above are plotted. A month as the basic time unit is a good compromise between practical and statistical considerations.

a. Update - The time series is updated as soon as it becomes informative to plot more points. This would normally be every three months. However, when the most recent update indicates a possible change in a basic pattern, the subsequent updates are monthly until the nature of the pattern is more evident. This normally requires one or two monthly updates. Once a positive identification of the pattern is made, updating resumes to normal frequency. Note that to trigger updating on a monthly basis, it is not necessary to detect a possible pattern change in all the time series. A possible change in just one time series is sufficient to trigger the update frequency.

Of interest might be a few comments on the computation of the dollar values of monthly demands for the three classes of items. These computations and the necessary data processing can be conveniently performed on a computer since the input data (unit prices and demand histories) are kept available for ADP applications for supply control studies. A very simple program that will compute the dollar value of monthly demand for each item, classify the item into the three categories, and sum the dollar values for each class can be executed, and output printed, just prior to a scheduled update. No computations are required in preparation for updating the program factor time series because the numbers to be plotted would be supplied from other sources, e.g., APSA, RAC, CDC.

b. Analysis - The analysis consists of inspecting and comparing the time series and applying intelligence available from awareness (which abounds in the manager more than in anyone else) to reach final decisions about the demand forecast parameters, i.e., length of demand forecast base and most advantageous use of program factors. Minimal algebraic effort is occasionally required in the analyses.

The decision to be made about the forecast base for each class of items is this: should the forecast base be increased, decreased, or kept unchanged? Any change made should normally be limited to 6 months. A 12 month change in the forecast base has too great an impact on all previously made forecasts. Less than a six month change might be too small for effectively responding to a demand change.

To make the decision about the forecast base for a particular class, the corresponding time series is examined for changes in the normal pattern. The things to look for are steps, ramps, cyclical or seasonal patterns (although these were not evident). When a change is evident, the base is reduced. When the change stabilizes the base is increased. The increase and reduction in the base are gradual (never more than a six month change) and correspond to the gradual changeover in a pattern. A base is never changed without an attempt to justify a pattern change. Occasionally a pattern will appear to be changing and there would be a good reason (known to the manager) for this. If this cause is known to have introduced a transient condition only, such as an impulse, the base should not be changed.

To determine which program factor may potentially be used to adjust the forecast, the program factor patterns are compared with each of the three demand time series. Similarity of the patterns is the key factor. If the time series pattern of a particular class is similar to the time series of one of the program factors, e.g., both are characterized by a ramp, or by a step, etc., then that program factor should be considered for use in adjusting the forecast for items in that class. The amount of weight given to the program factor would be determined from past behavior (see last paragraph of Appendix A). If the patterns are different, e.g., one is characterized by a step the other by a ramp, that program factor should not be used. Finally, if both program factors have similar patterns, pattern of that program factor for which the more accurate forecast is made(known at the source of the program data)should be used in the comparisons with the dollar demand time series.

The possibility of phasing (lag) for program factor-demand should not be overlooked. This would again be evident in the time series.

c. Application - The forecast parameters just determined are used to compute the demand forecasts for each item of the weapon system. These of course will in turn be used to compute the latest values of the requisitioning objectives, reorder warning points, etc., as is currently done.

To compute the demand forecast for a particular item the forecast parameters for the item's class are used as follows:

(1) Compute the program change factor (PCF) as is currently done.

(2) Compute average monthly demand (AMD) for the item as is currently done, using the base length found for the corresponding class.

(3) Forecast = AMD x [1 + W x (PCF - 1)] where W is the weight found for the corresponding class (see Appendix A).

This is done for every month in the forecast horizon and for every item.

d. Other - Whoever is supplying the program factor information should compare the time series of the forecasts of program factors with the corresponding time series of the actual values of the program factors to make sure that forecasts of program factors are satisfactory. If they are not, there is no sense in using program factors in adjusting the demand forecasts until more accurate procedures for forecasting program factors are developed. This might mean that different type of information or different theory must be used in making program factor forecasts.

To start "Art" forecasting two years of past data should suffice as initial time series. The initial values of the forecast parameters can be determined from these time series. Subsequent changes of these forecast parameters should not be too frequent. However, the environment does change and demand may change significantly with it. "Art" forecasting is designed to detect this condition when it occurs.

## ACKNOWLEDGEMENTS

The cooperation of all parties concerned in providing the information and data needed for this study is greatly appreciated. Thanks are in order for Mr. Bob Larson and his staff at the Intensive Management Office who provided information helpful in arriving at the assumed true averages for the patterns. Mr. Clyde Fowler and his staff at Weapons Command provided the MILSTRIP data. Mr. Bossenga from Research Analysis Corporation supplied the NCR-500 data. Finally, Colonel Connerat and Mr. Sardella, both from RAC, were very helpful in making available the COLED-V data.

## APPENDIX A

### (U) ESTIMATING PROGRAM FACTOR-DEMAND RELATIONSHIP IN "ART" FORECASTING

The demand-program factor relationship needed in "art" forecasting can be modeled by

$$\hat{D}(t+T) = F[W(t)\cdot\Delta P(t+T-d),\ \bar{D}(t)] \tag{1}$$

where

$d$ = lag in months

$\hat{D}(t+T)$ = forecast of demand (or \$ demand) T months from t

$F$ = symbol designating a functional relationship

$W(t)$ = weighting factor at time t

$\Delta P(t+T-d)$ = deviations from base period average value of a program factor for period $(t+T-d)$

$\bar{D}(t)$ = average value of demand through time t

This is merely a general form of a very simple model in which only one program factor is used at a time. It is not made more specific because the functional form of the relationship may vary from time to time, although, in general, it is expected to be linear. Present procedures assume that the form is linear. The analyses of this report show that a linear assumption is valid. However, the models for present procedures and what was found are not the same. We illustrate this.

For the current procedures equation (1) reduces to

$$\hat{D}(t+T) = \bar{D}(t)\cdot[1+\Delta P(t+T)] \tag{2}$$

According to the results of the analyses the relationship that best describes the actual situation depends on the class. For cleaning items, integral parts, and accessory items, these relationships are respectively

$$\hat{D}(t+T) = \bar{D}(t)\cdot[1+0.6\Delta P(t+T)] \tag{3}$$

$$\hat{D}(t+T) = \bar{D}(t)\cdot[1+0.6\Delta P(t+T-3)] \tag{4}$$

$$\hat{D}(t+T) = \bar{D}(t) \tag{5}$$

For equation (2) $\Delta P$ refers to the change in density. For equation (3) and (4), $\Delta P$ refers to round expenditure. Equation (5) is independent of $\Delta P$, that is, $W(t) = 0$. We also note that in (2), $W(t) = 1$ and $d = 0$. In (3) and (4), $W(t) \approx 0.6$, and $d = 0$ for (3) and $d = 3$ for (4).

To use this model, the various elements need to be estimated. The average value of past demand, $\overline{D}(t)$, and the change in the program factor are external to the model. That is, they are inputted from another source. The elements that need to be estimated are F, W(t), and d, and any other constants that might be appropriate after the form of F is properly estimated. Here the concern is only with F, W(t), and d.

Since there are so many sources of possible errors (variability in the variables, data errors from numerous sources) which make the model merely an approximation, time consuming and complex procedures for precise estimates are not desirable. Furthermore, the demands of "art" forecasting obviously do not require them. Graphical approach is the simplest and sufficient for our purposes. To estimate the form of F inspection of a plot of demand versus the program factor or from comparison of the time series plots of the two variables is all that is necessary. Satisfactory estimates of W(t) and d can also be made by inspection. For example, if the time series reveal that a change in the program factor results immediately in a change in demand, d would be estimated to be zero. If no specific lag were apparent d would again be set to zero. A value other than zero would be assigned to d only if there were a clear lag, in which case the amount of the lag would be evident. If the lag is so obscured that more sophisticated techniques are required to uncover it, it is best not to use a lag.

Similarly, if a 200% change in program factor always results in a 100% change in the same direction for demand, and if other amounts of increase for the variables are always in the same proportion, W(t) is clearly 0.50. If the proportion is not always the same, W(t) would be estimated on an average basis. If the direction of the change is not consistent for demand and the program factor, W(t) would be set to zero, which means that a program factor will not be used to adjust demand forecast because there is no correlation.

APPENDIX B (U) LIST OF PARTS STUDIED

A - accessories — if blank - integral part

C - cleaning — if excluded - little data and no unit price

G - configuration change

| FSN | NOMENCLATURE | UNIT PRICE | HOW CLASSIFIED |
|---|---|---|---|
| 1005-017-9537 | PIVOT PIN | .58 | |
| 017-9538 | PLUNGER ASSY | .76 | |
| 017-9539 | FORWARD PAWL | .59 | |
| 017-9540 | PAWL DETENT | .08 | |
| 017-9541 | SPRING | .09 | |
| 017-9542 | UPPER RECEIVER | 7.39 | |
| 017-9543 | GUN SLING SWIVEL | .22 | A |
| 017-9546 | CHARGING HANDLE | 2.97 | |
| 017-9547 | FIRING PIN | .66 | |
| 017-9548 | BOLT CATCH | .66 | |
| 017-9549 | STOCK ASSEMBLY | 3.45 | |
| 017-9551 | HAMMER ASSEMBLY | 1.82 | |
| 056-2201 | MAGAZINE CATCH | .41 | |
| 056-2237 | MAGAZINE (20 ROUND) | 1.34 | A |
| 056-2246 | BOLT CATCH SPRING | .02 | |
| 056-2247 | PLUNGER | .03 | |
| 056-2250 | PISTOL GRIP | .54 | |
| 056-2251 | LEFT HAND GUARD | .56 | |
| 056-2252 | RIGHT HAND GUARD | .56 | |
| 056-2253 | BARREL | 16.91 | |
| 089-3994<br>999-2035 | CLEANING ROD | 1.34 | C |
| 523-8084 | SPRING | .08 | |
| 569-8455 | ________ | ____ | EXCLUDED |

APPENDIX B

| FSN | NOMENCLATURE | UNIT PRICE | HOW CLASSIFIED |
|---|---|---|---|
| 1005-654-4058 | SLING | .35 | A |
| 738-6213 | BOLT CARRIER | 9.81 | G |
| 791-3377 | LUBRICATING CASE | .08 | C |
| 878-6589 | BARREL & SIGHT ASSY | 25.00 | |
| 903-1296 | BORE BRUSH | .09 | C |
| 912-4248 | SWAB | .50 | C |
| 933-8089 | FLASH SUPPRESSOR | .98 | G |
| 937-3078 | BUFFER ASSEMBLY | 4.00 | G |
| 978-1022 | EJECT. PORT COVER | .46 | |
| 978-1023 | EJECT. PORT COVER PIN | .05 | |
| 978-1025 | EJECT. PORT COVER SPRING | .03 | |
| 978-1026 | REAR SIGHT | .53 | |
| 978-1027 | REAR SIGHT SPRING | .02 | |
| 978-1028 | WINDAGE SCREW | .26 | |
| 978-1029 | DRUM | .20 | |
| 978-1030 | DETENT | .03 | |
| 978-1032 | DETENT SPRING | .02 | |
| 978-1034 | BARREL NUT | .99 | |
| 978-1035 | SLIP HAND GUARD AND RING | .90 | |
| 978-1036 | SLIP RING SPRING | .60 | |
| 978-1038 | GAS TUBE | 1.67 | |
| 979-3924 | HAND GUARD CAP | .26 | |
| 979-3926 | FRONT PIN | .04 | |
| 979-3929 | FRONT SIGHT PORT | .28 | |
| 979-3930 | DETENT | .07 | |
| 979-3931 | FR. SIGHT DETENT SPRING | .02 | |
| 992-6648 | HAMMER SPRING | .07 | |
| 992-6649 | AUTO. SEAR | .39 | |
| 992-6650 | AUTO. SEAR PIN | .04 | |
| 992-6651 | BUFFER RETAINER | .09 | |

APPENDIX B

| FSN | NOMENCLATURE | UNIT PRICE | HOW CLASSIFIED |
|---|---|---|---|
| 1005-992-6652 | BUFFER RETAINER SPRING | .04 | |
| 992-6653 | TAKE DOWN PIN | .56 | |
| 992-6654 | TAKE DOWN PIN DETENT | .04 | |
| 992-6655 | DETENT SPRING | .03 | |
| 992-6657 | BUTT CAP SCREW | .05 | |
| 992-6665 | SPRING ACTION | .52 | |
| 992-6666 | SAFETY | .77 | |
| 992-6667 | SAFETY DETENT | .04 | |
| 992-6676 | BIPOD | 1.85 | A |
| 992-7280 | LOCK FL. SUP. WASHER | .02 | |
| 992-7283 | BOLT CARRIER KEY | 3.64 | |
| 992-7284 | CAR. & KEY SCREW | .04 | |
| 992-7285 | BOLT ASSEMBLY | 8.15 | G |
| 992-7287 | BOLT RING | .05 | |
| 992-7288 | EXTRACTOR | 1.37 | |
| 992-7289 | EXTRACTOR SPRING | .03 | |
| 992-7290 | EXTRACTOR PIN | .05 | |
| 992-7291 | EJECTOR | .08 | |
| 992-7292 | DETENT SAFETY SPRING | .04 | |
| 992-7294 | BOLT CAM PIN | .36 | |
| 992-7297 | LOWER RECEIVER EXTENSION | 2.72 | |
| 992-7299 | TRIGGER GUARD | .52 | |
| 992-7301 | MAGAZINE CATCH SPRING | .03 | |
| 992-7302 | MAGAZINE CATCH BUTTON | .05 | |
| 992-7307 | TRIGGER | 1.37 | |
| 992-7308 | TRIGGER SPRING | .04 | |
| 992-7309 | HAMMER & TRIG. PIN | .04 | |
| 992-7311 | DISCON. SPRING | .05 | |
| 999-0404 | CHG. HANDLE SPRING | .03 | |
| 999-0405 | CHG. HANDLE LATCH | .31 | |

APPENDIX B

| FSN | NOMENCLATURE | UNIT PRICE | HOW CLASSIFIED |
|---|---|---|---|
| 1005-999-0406 | DISCONNECTOR | .79 | |
| 999-1435 | CHAMBER BRUSH | .19 | C |
| 999-2430 | BIPOD CASE | .77 | A |
| 1095-508-0339 | SCABBARD | ____ | EXCLUDED |
| 4933-070-7814 | HEAD SPACE GAGE | ____ | EXCLUDED |
| 070-7815 | FIRING PIN GAGE | ____ | EXCLUDED |
| 994-7084 | CARRYING CASE | ____ | EXCLUDED |
| 5315-999-1509 | FIRING PIN RETAINING PIN | .23 | |

## APPENDIX C

## (U) TYPICAL LEDGER SHEET

| FSN PART NUMBER / PUBLICATION NUMBER | STORAGE CODE | UNIT OF ISSUE | RECOV CODE | CATEGORY CODE | ROUTING IDENTIFIER | ECHELON CODE | UNIT PRICE / MINIMUM BALANCE | REQUISITION OBJ FACTOR* / STOCK FUND | FSN SUBSTITUTIONS / REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 10057 913377 | | | | | | | .08 | 20833 | |
| | Q | EA | | M | WRR | | 500 | 02 | |

| ORGANIZATION SUPPLY CODE | PRI | DATE | DOCUMENT NUMBER | TRANS CODE | QUANTITY | REQUISITION OBJECTIVE | SERVICEABLE ON HAND | DUE OUT | DUE IN | UNSERVICEABLE ON HAND |
|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN2768 | | 99 | | 720 | 516 | 25 | 229 | |
| DF26C | 05 | JAN2968 | 80230073 | 40 | 02 | 720 | 514 | 25 | 229 | 00 |
| | | FEB1 68 | 80260003 | 15 | 124 | | | | | |
| DGN8T | 12 | FEB1 68 | 80220009 | 42 | 23 | 720 | 615 | 02 | 229 | 00 |
| DF8118 | 05 | FEB6 68 | ✓80320003 | 40 | 250 | | | | | |
| DGPHU | 12 | FEB6 68 | 80300004 | 40 | 20 | | | | | |
| DGGA0 | 12 | FEB6 68 | 80290123 | 40 | 100 | 720 | 245 | 02 | 229 | 00 |
| DFPHU | 05 | FEB1068 | 8030001[illegible] | 40 | 150 | | | | | |
| T8IWQ | 12 | FEB1068 | 80411055 | 31 | 507 | 822 | 95 | 02 | 736 | 00 |
| DGMA2 | 12 | FEB1568 | 80370012 | 40 | 95 | | | | | |
| | | | | 33 | 333 | | | | | |
| T8IWQ | 12 | FEB1568 | 80471005 | 31 | 517 | 918 | 00 | 335 | 1253 | 00 |
| DF2D0 | 05 | FEB1968 | 80450013 | 49 | 02 | | | | | |
| DFY.0 | 12 | FEB1968 | 80360012 | 33 | 18 | | | | | |
| DFYC0 | 12 | FEB1968 | 80360002 | 33 | 20 | 918 | 00 | 375 | 1255 | 00 |
| DGCMA | 12 | FEB2268 | 80370102 | 33 | 150 | 918 | 00 | 525 | 1255 | 00 |
| DF4B0 | 12 | FEB2568 | 80530103 | 33 | 1000 | | | | | |
| T8IWQ | 12 | FEB2568 | 80561011 | 31 | 1219 | 949 | 00 | 1525 | 2474 | 00 |
| DF8DI | 12 | MAR 168 | ✓80310001 | 33 | 197 | 949 | 00 | 1722 | 2474 | 00 |
| DF6HA | 05 | MAR 968 | 80650602 | 49 | 100 | | | | | |
| | | MAR 968 | 80471005 | 11 | 517 | | | | | |
| DFY.0 | 12 | MAR 968 | 80360002 | 42 | 20 | | | | | |
| DGCMA | 12 | MAR 968 | 80370102 | 42 | 150 | | | | | |
| DGMA2 | 12 | [illegible] | 80370012 | 42 | 333 | 949 | 14 | 1319 | 2057 | 00 |
| | | MAR1868 | 80471005 | 11 | 517 | | | | | |
| DF4B0 | 12 | MAR1868 | 80530103 | 42 | 531 | | | | | |
| | | MAR1868 | | 33 | 469 | 949 | 00 | 788 | 1540 | 00 |
| | | APR 968 | | | | 1011 | 00 | 788 | 1540 | 00 |
| | | APR2068 | 81110003 | 15 | 200 | | | | | |
| DF8EI | 12 | APR2068 | ✓81070104 | 40 | 200 | | | | | |
| | | | | 33 | 465 | | | | | |
| T8IWQ | 12 | APR2068 | 81121007 | 31 | 862 | 1149 | 00 | 1253 | 2402 | 00 |
| | | APR2168 | 81100003 | 15 | 200 | 1149 | 200 | 1253 | 2402 | 00 |
| DF8DJ | 12 | APR2168 | 80310001 | 42 | 197 | | | | | |
| DFYC0 | 12 | APR2168 | 80360012 | 42 | 03 | | | | | |
| | | APR2168 | | 33 | 15 | 1149 | 00 | 1053 | 2402 | 00 |
| | | MAY1 68 | 81231113 | 15 | 200 | | | | | |
| DF4B0 | 12 | MAY1 68 | 80530103 | 42 | 200 | | | | | |
| | | | | 33 | 269 | 1147 | 00 | 853 | 2402 | 00 |
| | | MAY1068 | 81300122 | 15 | 200 | | | | | |
| DF8EI | 12 | MAY1068 | 81070104 | 42 | 200 | | | | | |
| | | | | 33 | 265 | 1149 | 00 | 653 | 2402 | 00 |
| DFY80 | 05 | MAY1968 | 81310101 | 49 | 5000 | 1149 | 00 | 5653 | 7402 | 00 |
| | | MAY2568 | 72521038 | 32 | 1097 | | | | | |
| DF4B0 | 05 | MAY2568 | 81410513 | 49 | 10 | | | | | |
| DGDAA | 12 | MAY2568 | 81420601 | 33 | 08 | 1008 | 00 | 5671 | 6315 | 00 |

| CODE | TITLE |
|---|---|
| 11 | Receipt D I (Complete Serviceable) |
| 12 | Receipt D I (Partial Serviceable) |
| 13 | Receipt D I (Over Shipment Serviceable) |
| 14 | Receipt D I (Short Shipment Serviceable) |
| 15 | Receipt Not Due In (Serviceable) |
| 16 | Receipt Not Due In (Unserviceable) |
| 21 | Adjustment (Serviceable to Unserviceable) |
| 22 | Adjustment (Unserviceable to Serviceable) |
| 23 | Inventory Adjustment (Cycle) Balance in Agreement |
| 24 | Inventory Adjustment (Cycle) Serviceable Increase or Decrease |
| 25 | Inventory Adjustment (Cycle) Unserviceable Increase or Decrease |
| 26 | Inventory Adjustment (Special) [illegible] (Complete) |
| 31 | Due In Established |
| 32 | Due In Cancelled |
| 33 | Due Out Established |
| 34 | Due Out Cancelled |
| 40 | Issue Serviceable (Recurring) |
| 41 | Issue Serviceable (Non Recurring) |
| 42 | Issue (Due Out Release) |
| 43 | Turn In Serviceable |
| 44 | Turn In Unserviceable |
| 49 | Passing Order |
| 99 | Ledger Re construction |

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13. ABSTRACT

This report contains results of an empirical study of the relationship that exists between demand for parts of the M16 Rifle and rifle density or round expenditure. Actual demands from Vietnam and the actual monthly density and round expenditure in Vietnam for 1967 and 1968 are used in the analyses.

Relationships are examined for the BSU and the NICP levels of supply. Patterns of overall round expenditure and density as well as patterns of a finer breakdown of the overall, i.e., by type of mission, terrain, and combat status of units, are compared with patterns of demand and dollar value of the demand for individual items, for the catalog of items, and for aggregation of items by three class types. Forecasts of density and round expemditure as given in DA-1322 reports are compared with the actual values.

For both levels of supply, density appears to have no bearing on demand. Round expenditure seems to affect demand but the changes are not proportional. Forecosts of round expenditure are not very good. A demand forecast methodology is suggested and guidelines given to what extent future analysis of this type should be carried.

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